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ENGINEERING AND EQUIPMENT

No. 61

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USSR REPORT

ENGINEERING AND EQUIPMENT

No. 61

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

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ENGINEERING AND EQUIPMENT

AN ANALYTICAL METHOD OF CALCULATING THE TRANSIENT ONE-DIMENSIONAL FLOW
OF A FLUID

GONOR, A. L., Institute of Mechanics, Moscow State University imeni
M. V. Lomonosov

[Abstract] A new method is proposed for calculating the transient flow
of a fluid with a plane, cylindrical, or spherical symmetry. The equations
of motion and continuity are solved for two zones within the perturbation
region, by asymptotic expansions in each and their subsequent collocation.
Shock waves are arbitrarily excluded from consideration, such a wave
would be replaced with an equivalent compression wave. The fluid is re-
garded as being only slightly compressible and its change of entropy is
assumed to be negligible. The results of calculations are compared with
those obtained by the acoustic approximation including nonlinear terms
and the latter found to be accurate only in the case of spherical symmetry.
In the other cases it is necessary to more precisely evaluate the Cauchy-
Lagrange integral involving the velocity potential. The author thanks
V. N. LIKHACHEV for the participation in this study. The article was
presented by academician L. I. SEDOV on 27 Mar 79. References 3 (Russian).
[299-2415]

EFFECTS OF VIBRATION ON AIR BUBBLES IN A LIQUID

YEMEL'YANOV, A. F. and SHOYKHEDBROD, M. P., Institute of Chemistry imeni
V. N. NIKITIN, Tadzhik SSR Academy of Sciences [presented by Academician
P. M. Solozhenskiy, Academy of Sciences, Tadzhik SSR, 25 December 1978]

[Abstract] A number of experimental studies have been made on the effect
of vibrations on air bubbles in a liquid under conditions close to
weightlessness; the data obtained, however, had no theoretical basis. An
attempt is made to give a theoretical description for both the effect of
vibrations on air bubbles under normal gravity conditions and under con-
ditions approximating those of weightlessness. It is assumed that the
primary forces acting on air bubbles at altitudes above 240 km are the

intermolecular forces, or surface tension, and the aerodynamic drag on the spacecraft, the latter becoming negligible at higher altitudes. Potential energy terms for the potential energy of air within a bubble, for the energy of surface tension at the liquid surface and the surface of the bubble, and for external forces are inserted into the Lagrange equation for such a system, with the kinetic energy terms the same as in the equation for such a system, with the kinetic energy terms the same as in the equation for normal gravity. Solution of the resulting differential equations gives an equation which can be used to determine the conditions under which bubbles in a liquid will rise, sink or remain at the same level. Figure 1; references 9: 5 Russian, 4 Western.

NEMKOV, V. S., Leningrad

[Abstract] Objects having the form of non-circular hollow cylinders, pipe of varying wall thickness, etc. are encountered in induction heating practice. The calculation of the magnetic field in such objects is a complex two-dimensional problem even when the inductor is of considerable length. However, it is shown that this problem can be solved on the basis of solutions for plane and cylindrical electromagnetic waves. The solution is derived in the form of formulas that are extremely simple with respect to thin shells. It is shown that, in general, when the dimensions of the body being heated assure a minimum or a maximum of reactance, the condition $r = x$ (reactance = resistance) is always satisfied. The developed method combines the advantages of the numerical and analytic methods and assures an effective calculation of the parameters of multilayer cylinders with a varying distribution of resistivity and permeability. Sample calculations are presented. Figures 3; references 3 (Russian). [313-1386]

UDC 621.1.013:536.423.1.001.45

FLOW OF A STEAM-AND-WATER MIXTURE UNDER HIGH PRESSURE THROUGH CYLINDRICAL CHANNELS

KHLESTKIN, D. A. and KANISHCHEV, V. P., Moscow

[Abstract] The flow of a steam-and-water mixture with the initial pressure P_0 = 3-22.1 atm and initial gravimetric steam content x_0 = 0-1 was experimentally investigated in short cylindrical channels measuring 3.6 and 4.5 mm in diameter and 3.5 and 0.1 of the caliber in length. The mixture was produced by direct mixing of cold water with superheated steam as well as by throttling underheated water. Flow formulas developed by earlier investigators are recommended depending on channel dimensions and the value of x_0. Limits of the critical conditions of the flow of hot water and steam-and-water mixture in the presence of high P_0 are for the first time experimentally determined. A theoretical model and working formulas are developed for determining the critical flow rate of steam-and-water mixtures at $x_0 < 0.02$. The rated values of static pressures in the metastable range of flow regimes are experimentally corroborated. Figures 5; references 9: 7 Russian, 2 Western.
[313-1386]

UDC 62-156:532.5-1/-9.031.001.24

CALCULATION OF STEADY-STATE AXISYMMETRIC EDDY FLOW OF AN INCOMPRESSIBLE INVISCID FLUID IN A RADIAL-AXIAL-FLOW TURBINE

ZABOLOTNYY, F. T., Leningrad

[Abstract] The problem of steady-state three-dimensional flow of inviscid fluids in turbines usually reduces to two two-dimensional problems: averaged axisymmetric flow through blade cascades, and flow around blade curvatures. The direct axisymmetric problem is now calculated with respect to the axisymmetric flow of an incompressible inviscid fluid in the stages of hydraulic turbines of the combined radial and axial flow type, on the basis of the numerical variational-difference method (method of finite elements) using a program in ALGOL-60. The averaged equations describing the axisymmetric eddy flow of an incompressible inviscid fluid in a

coordinate system rotating together with the rotor, which corresponds
to the model of flow through a turbine with an infinitely large number
of blades, are derived. Axisymmetric flow in a high-power hydraulic
turbine of the radial-axial flow type, designed for the Sayano-Shushenskaya
Hydroelectric Power Station, is calculated by way of an example. The
numerical method of solution, developed and implemented on a BESM-6
computer, can be used for research into the theory of flow in turbine stages
of the above type with the object of their optimization, adjustment, and
analysis of experimental data. Figures 4; references 15: 14 Russian,
1 Western [in Russian translation].
[313-1386]

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HEAT TRANSFER FROM A CYLINDER IN A TRANSVERSE FLOW WITH SURFACE BOILING
IN A LIQUID FLUIDIZED BED

TUSHIN, A. M., VASANOVA, L. K. and SYROMYATNIKOV, N. I., Ural Polytechnical
Institute imeni S. M. Kirov, Sverdlovsk

[Abstract] The process of nucleate boiling of liquids heated to the
saturation point is extensively used for effective cooling of heat-stressed
components. The authors consider the feasibility of intensifying heat
exchange in surface boiling of fluidizing a bed of finely dispersed solid
material. Experiments are done on the influence that the fluidized solid
particles have on the intensity of heat exchange at atmospheric pressure
in a stainless steel loop. The bed was made up of alundum particles
fluidized by injection of water from beneath through a perforated plate.
The heating element was a stainless steel tube in the fluidized bed trans-
verse to the water flow. The temperature of the tube and of the inlet and
outlet water was measured by thermocouples. The experiments were done at
heat flux densities from 55 to 2560 kW/m^2, including regimes of convective
heat exchange without boiling and with surface boiling of the fluidized
medium. Analysis of the results shows that the solid particles transfer
apparent mass of the unheated fluid to the wall region, which reduces the
excess heat of the heat-transfer surface and the layer of fluid near the
wall, and hence deactivates nuclei of vapor formation. Turbulent mixing
also intensifies condensation of vapor bubbles. Under these conditions,
there are not many active nuclei of vapor formation, but new centers are
activated as superheating increases, and even a small change in the number
of such nuclei makes a considerable contribution to the overall intensity
of heat exchange, and there is an abrupt rise in heat flux density.
Figures 3; references 10: 8 Russian, 2 Western.
[151-6610]

HEAT TRANSFER OF A CYLINDER IN A TRANSVERSE FLOW INVOLVING SURFACE BOILING
IN A LIQUID FLUIDIZED BED

TUSHIN, A. M., VASANOVA, L. K., SYROMYATNIKOV, N. I., Urals Polytechnical
Institute imeni S. M. Kirov, Sverdlovsk

[Abstract] Water was electrically heated in a stainless steel pipe con-
taining aluminum pellets in order to determine convective heat transfer
both in the absence of boiling and during surface boiling in the bed. In
the series of experiments the basic parameters had the following range:
$q = 55 - 2560$ kWt/m^2, $w = 0.06 - 0.235$ m/s, $t_{fluid} = 9-60$ C $d = 0.95 - 2.33$
mm; epsilon = $0.633 - 0.914$. Kutateladze's method, as modified by
Pokhvalov was used to obtain $\frac{\alpha}{\alpha_0} = \frac{\alpha}{\alpha_0} 4.44qq^{0.14}$. Excess wall temperature
then levels off at $\Delta \eta /\alpha \frac{\alpha}{\alpha_0} \approx 2$. In FB heating the heat flux density
depends strongly upon underheating, except where wall superheating assumes
high levels. A comparison of these results with Fand, et. al. (Ref 9),
at similar superheating levels the heat flux density of the FB was double
that of surface boiling. Particle size and filtration rates do not have
as much influence upon boiling as does underheating. The bed particles
bring additional underheated liquid to the wall areas and deactivate steam
generation areas. Turbulent mixing also intensifies steam bubble conden-
sation. Heat flux density rises with superheating. Figures 3; references
10: 8 Russian, 2 Western.
[151-11,574]

PRESSURE DISTRIBUTION OVER THIN AIRFOILS IN SUPERSONIC FLOW

SERGEYEV, V. I.

[Abstract] A method for computing pressure distribution in supersonic
flow over thin airfoils with subsonic rectilinear and curvilinear leading
edges is presented. The method is based on the theory of conical and
quasi-conical motions. The Germain formulas linking the axial and vertical
components of perturbation velocity within the theory of conical flow are
used to derive the relationship between the axial perturbation velocity

and the normal component of that velocity and thereupon, on the basis of
a linear theory formula, to derive the distribution of the pressure co-
efficient over the airfoil. The proposed method is used to compile a
program in ALGOL for a BESM-6 computer, serving to determine pressure
distribution over the surface of planar and non-planar delta wings with
rectilinear leading edges, with greater accuracy than that of the numerical
method. Figures 8; references 8: 2 Russian, 6 Western.
[291-1386]

WAVE MECHANISM OF VIBRATORY DISPLACEMENT OF A LIQUID IN PIPES

GANIYEV, R. F., PODCHASOV, N. P. and UKRAINSKIY, L. YE., Institute of
Mechanics, Academy of Sciences of the Ukrainian SSR, Kiev

[Abstract]   Vibratory displacement of an incompressible viscous fluid
during laminar or turbulent flow at fairly high velocities through pipes
of fairly large diameters is analyzed, particularly with propagation of
traveling waves of small amplitudes along the pipe wall. Isothermal
axisymmetric flow, steady and thus independent of the initial conditions
as well as of time, is considered in an infinitely long stationary pipe
which in the undeformed state has a circular cross section. Compounding
of forward motion and wave motion of the liquid is found to be determined
by interaction of viscous and inertial forces as well as by nonsteady
adhesion to the pipe wall. The relevant boundary-value problems have
been solved by numerical integration for standstill, Poiseuille flow and
steady turbulent flow. Velocity profiles have been obtained correspondingly
for air, oil and water within the appropriate ranges of the Reynolds
number and the Strouhal number. The results indicate that realization of
these vibratory displacement mechanisms can substantially improve the
pipeline capacity. Figures 2; references 8:   7 Russian, 1 Western.
[316-2415]

LONGITUDINAL OSCILLATIONS OF A THIN VESSEL IN DEEP WATER

YURKEVICH, Yu. I., Odessa Institute of Maritime-Fleet Engineers

[Abstract] The problem of small longitudinal oscillations is solved for
a thin Mitchell vessel floating at standstill on deep water. The water
is assumed to be an ideal and incompressible fluid, its volume infinitely
deep and its motion potential. The pertinent equations are solved ac-
cording to the linear theory for the sought potential $\Phi(x,y,z,t) = \Phi_c(x,y,z)$
$\cos\sigma t + \Phi(x,y,z)\sin\sigma t$ (σ denoting the frequency of oscillations) in the
region (x,y,z) (t_0 of the lower half-space notched by the vessel). The
solution is found in a closed form and used also for calculating the
damping of vertical oscillations. Numerical results have been obtained
for Series 60 ships. Figures 2; references 11: 6 Russian, 5 Western.
[116-2415]

EFFECT OF THE BASE REGION ON STREAMLINE FLOW WITH INJECTION AROUND
AXISYMMETRIC BODIES

ANTONOV, A. N. and ZATSEV, A. A., Kiev State University

[Abstract] Adequate thermal protection of supersonic aircraft depends
largely on an intensive mass transfer. Here axisymmetric bodies of finite
length are considered in a supersonic air stream with uniformly spread
air injection through the surface. With the concept of a Prandtl boundary
layer, assuming a very high Reynolds number and a very thin body allows
splitting the problem into two, an external one for the region between
shock wave and separation surface, and an internal one for the region
between separation surface and body surface. In the internal problem the
degenerate Navier-Stokes differential equations reduce to a system of
integro-differential equations which can be solved only by asymptotic
expansions. Here a solution is obtained by approaching the nose of a
body with an axisymmetric power-law profile $r = cx^k$ ($0 < k < 1$). The authors
thank G. A. OKLAND for the interest in this study. Figures 3; references
5: 4 Russian, 1 Western.
[116-2415]

RESONANCE FREQUENCIES OF CYLINDRICAL SHELLS WITH LIQUID

DODKIN, F. S., Institute of Mechanics, Academy of Sciences of the
Ukrainian SSR, Kiev

[Abstract] A practical engineering formula is derived for calculating
the resonance frequencies of vibration devices such as liquid containers.
For a cylindrical shell partially filled with liquid the frequency is
equal to the velocity of a pressure wave through the system divided by
the wavelength. This yields

$$f_1 = \frac{1}{4L} \sqrt{\frac{K}{\rho(1 + \frac{KD}{Eb})}} \quad \text{for the fundamental mode}$$

and

$$f_n = \frac{1}{4L} \sqrt{\frac{1}{\rho(\chi + \frac{D}{Eb})}} \quad \text{for the higher harmonics}$$

L - height of the liquid column
b - thickness of the shell wall
D - diameter of the cylindrical shell
E - modulus of elasticity of the shell material
ρ - density of the liquid
$K = U_1(\frac{P_2 - P_1}{U_1 - U_2})$ - bulk modulus of the liquid

Experimentally the resonance can be determined from the maximum acceleration
measured during vibrations at a variable frequency under a constant load.
Readings thus obtained for a container made of acrylic glass and half
full with water agree within 14% with values based on the formula. Figures
2; references 5: 1 Russian, 4 Western.
[116-2415]

REFLECTION OF WEAK SHOCK WAVES IN AIR BY PLANE BARRIERS MADE OF VARIOUS
MATERIALS

ANIK'YEV, I. I., Institute of Mechanics, Academy of Sciences of the
Ukrainian SSR, Kiev

[Abstract] Normal reflection of weak shock waves by plane panels made of
various materials was measured with a piezoelectric velocity transducer
feeding signals through an emitter-follower transistor stage to an oscil-
lograph. The tests were performed in a shock tube 140x205 mm in cross
section, consisting of a 1.5 m long high-pressure segment and a 4 m long
low-pressure segment separated by a 0.2 mm thick barrier. The velocities
of incident and reflected wave fronts were determined, accurately within
2%, from the intervals between signal peaks relative to the time base.
On the basis of these data, then, it is possible to evaluate the dynamics
behind the front of a shock wave reflected by a real panel relative to the
dynamics of reflection by a perfectly rigid barrier. The panels in this
experiment were made of foam polyurethane 30 mm thick, glass cloth 0.5 mm
thick, glass plastic 50 mm thick, steel 8 mm thick, and rubber 0.5 mm
thick. At the beginning of interaction with a weak shock wave, according
to the results, plane panels of different thicknesses and with different
physical properties all behave like perfectly rigid barriers. Figures 4;
references 2: 1 Russian, 1 Western.
[316-2415]

MOVEMENT OF A NONLINEARLY VISCOUS MEDIUM IN A CYLINDRICAL CHANNEL OF
ARBITRARY CROSS SECTION

KUZIN, V. G., Institute of Mechanics, Ukrainian Academy of Sciences,
Kiev

[Abstract] The problem of the steady movement of nonlinearly viscous
media in cylindrical channels of arbitrary cross section is reduced to
the solution of a single equation with a single boundary condition. It
is found that under these conditions, the presence of a "rigid core" in

the central portion of the channel is characteristic. The influence of nonlinear terms is great, and the solutions vary by several orders of magnitude, depending on whether nonlinearity is considered or not. Figures 2; references 8: 7 Russian, 1 Western.
[317-6508]

STUDY OF THE MOVEMENT OF FINELY DISPERSED INCLUSIONS IN AN OSCILLATING VESSEL CONTAINING A LIQUID WHICH CONTAINS A COMPRESSIBLE SPHERE

GANIYEV, R. F., KULIK, V. V., MALYSHEV, P. A. and TSAPENKO, A. S., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] This work presents experimentally derived equations describing the dynamic behavior of solid and gaseous inclusions in a liquid which partially fills a vessel that oscillates in the vertical direction. In addition to finely dispersed particles and bubbles, the liquid also contains a spherical cavity made of an elastic material filled with a gas. The primary task of these studies was to establish the specifics of the vibrational movement and vibrational stability of the small gas bubbles and solid particles in the vicinity of the sphere, which pulsates due to the compressibility of the gas. The experimental installation is described and diagrammed. The introduction of the gas cavity results in the formation of a new oscillating system, with the gas cavity acting as an elastic element, and the liquid acting as an inertial element. Near the pulsating sphere are attracting manifolds in the form of spherical surfaces, toward which the small gas bubbles are attracted, tending to take up stable positions on these surfaces; the solid particles move to the surface of the pulsating sphere and remain on it, given the proper particle density and amplitude of oscillations. Figures 6; references 2: 1 Russian, 1 Western.
[317-6508]

INFLUENCE OF LONGITUDINAL CURVATURE ON THE AERODYNAMIC CHARACTERISTICS
OF PLANE CHANNELS

MAZO, A. S.

[Abstract] A systematic mathematical study is presented of the influence
of the longitudinal curvature on the mean characteristics of a turbulent
flow in a channel with cylindrical walls - the velocity profile, shear
stress profile, and drag coefficient - for various values of Re number.
Stabilized flow is considered, in which the velocities do not change
longitudinally. The fluid moving through the channel, formed by two
coaxial cylinders, is considered to be incompressible. The effect of
the curvature of the channel increases with increasing Reynolds number.
Calculated and experimental results are compared. Figures 4; references
11:   7 Russian, 4 Western.
[285-6508]

CALCULATION OF THERMAL DIFFUSION SEPARATION PROCESSES IN A SYSTEM WITH
A TRAVELING MAGNETIC FIELD

KARCHEVSKIY, A. I. and POTANIN, YE. P.

[Abstract] The process of separation of isotopic mixtures of xenon is
described, considering the radial heterogeneity of the parameters of the
system, and the separating capacity of the system is estimated. The
system is a gas-discharge device with a traveling magnetic field in which
thermal diffusion plays a significant role in the process of separation
in a certain range of pressures due to the forced electromagnetic con-
vection which occurs under these conditions. Figure 1; references 9:
8 Russian, 1 Western.
[285-6508]

THEORY OF THERMOMOLECULAR PRESSURE AND THE MECHANICAL-CALORIC EFFECT
IN A CYLINDRICAL CHANNEL

CHERNYAK, V. G., KALININ, V. V. and SUYETIN, P. YE., Ural State University,
Sverdlovsk

[Abstract] The purpose of this work is, first of all, to obtain a solution
to the problem of the thermomolecular pressure throughout the entire range
of values of Kn numbers, based on a correct kinetic equation and, secondly,
using a special model of the boundary conditions, to explain the variation
of gamma with the type of gas. A study is made of the movement of a mono-
molecular, single-component gas in a cylindrical capillary with a longi-
tudinal pressure and temperature gradient. Figures are used to compare
the theoretical and experimental results under various conditions. Figures
3; references 8: 4 Russian, 4 Western.
[285-6508]

INFLUENCE OF THE SPECULAR COMPONENTS OF SURFACE REFLECTION ON THE
RADIATION CHARACTERISTICS OF A HERRINGBONE CAVITY

SKOVORODKIN, A. I.

[Abstract] Analysis of radiant heat exchange in a herringbone cavity
is used to determine the full radiant fluxes departing from the cavity
through the intake and output apertures, related to the external flux, i.e.,
the hemispherical mean coefficients of reflection and transmission of the
cavity averaged over the surface. The cavity may be illuminated with
either diffuse or collimated external radiation, and the radiation of
the surfaces and external radiation from the rear side are negligible
in comparison to the primary incident radiation. A homogeneous specular-
diffuse model of reflection is used, according to which the hemispherical
coefficient of reflection can be represented as the sum of the specular
and diffuse components. Figures 4; references 9: 6 Russian, 3 Western.

SOME CHARACTERISTICS OF A PLASMA GENERATOR WITH AN INTERELECTRODE INSERT

SERGIYENKO, A. S., Institute of Heat and Mass Exchange imeni A. V. Lykov,
Academy of Sciences BSSR, Minsk

[Abstract] An examination is made of the stability characteristics of a
DC electric arc that is centered by a distributed air vortex lengthwise
of the discharge chamber with a sectionalized interelectrode insert. In
such blown-arc plasma generators, the current is amplified in the arc for
both positive and negative dynamic resistances. A critical analysis is
made of the Kaufman stability criterion for arcs of this type, i. e. a
positive value of the sum of the dynamic arc resistance and the resistance
of the ballast rheostat. It is shown that this condition is necessary,
but not sufficient for stability of a blown arc of fixed length. Correction
of the criterion should include terms that account for a "shunting"
mechanism. An arc burning under conditions of a distributed gas curtain
in a sectionalized channel has a dynamic factor that is positive in sign
and has an absolute value ranging from 1.05 to 1.28. Under conditions of
transient processes that occur at a frequency slower than 0.1 Hz, the

dynamic current-voltage curve of an arc of fixed length differs considerably from the static characteristic, both in shape and position. Therefore errors are introduced when the dynamic characteristic is ignored under these conditions in studying stability. Figures 3; references 11 (Russian).

[191-9110]

SOME CHARACTERISTICS OF A PLASMA GENERATOR WITH AN INTERELECTRODE INSERT

SERGIYENKO, A. S., Institute of Heat and Mass Transfer imeni A. V. Lykov, Belorussian SSR Academy of Sciences, Minsk

[Abstract] A plasma generator with a limited power source (0-400 V, 200 A) having a U shaped static current-voltage characteristic could only function within the range $R_{arc} > 0$. In spite of the fact that Kaufman's criterion ($K = R_{arc}^* + R_{ballast} > 0$) was met, it would not maintain an arc, indicating that the criterion is a necessary, but not sufficient condition. The fluctuation of the parameters is stochastic in nature. The amplitude frequency characteristics depend upon the absolute values of voltage, arc current and the gas flow rate. Regular fluctuations of VA were found within the -zone bounded by the diameter $= R_{arc}^* = -0.1$ Ohm. Guaranteed resistance to arc burning within the triangle ABC is found at $K = (0.37 - 1.18)$ Ohms. $K = 0.68$ Ohms is optimal. An empirical formula was derived: $R_{arc}^* = -AI^{-a}d^{-b}G G8 G^{-B}$. Where $A=392.6$; $a=1.148$; $b=0.426$; $c=0.574$; $\Gamma, \Gamma, \Gamma = $ Gas, Gas_1, Gas_2. The dynamic factor for a KMT-1 thermoresistor was positive and increasing, for a platinum wire it decreases slightly. Since Static VA are not always accurate, dynamic VA should be the basis of vigorous research. "Shunting" should be taken into consideration. The dynamic factor is positive for D_{arc} greater than 0, and variable for $D_{arc} = 1.05-1.28$. Figures 3; references 11 (Russian).

[191-11,574]

INVESTIGATION OF THE PUMPING MECHANISMS OF AN ASTROPHYSICAL WATER MASER
AT THE 1.35 cm WAVELENGTH

SHMELD, I. K., Radioastrophysical Observatory, Latvian SSR Academy of
Sciences

[Abstract] The discovery of cosmic maser radiation in the radio lines
of certain molecules, particularly of such compact sources as OH and H_2O,
is of major interest. As regards the H_2O sources, especially, their
angular dimensions are unusually small ($\leq 3 \cdot 10^{-4}$ sec of arc), while their
luminosity and brightness temperatures are unusually high ($\leq 10^{33}$ erg sec^{-1}
and $\leq 10^{15}$ K, respectively). In this connection the pumping mechanisms
of these sources are of special interest: first, the H_2O maser sources
observed in the direction of the galactic regions of ionized hydrogen are
closely connected with the processes of star production and second, the
H_2O radio line sources ($\lambda = 1.35$ cm), which are associated with cool stars,
are probably located in the dense gas-dust envelopes of these stars. It
is surmised that these mechanisms are based on the principle of the ab-
sorption or emission of quanta by cosmic dust, in a continuous spectrum
with frequencies corresponding to the frequencies of the spectral lines
in question. Calculations show that the most probable pumping mechanism
of cosmic H_2O maser sources is the collisions between water molecules and
surrounding atoms or molecules of hydrogen. References 10: 7 Russian,
3 Western.

CROSSTALK DISTORTIONS IN ACOUSTICOOPTICAL SPECTRAL ANALYZERS

INDZHIYA, F. I., CHERNOV, B. K. and YAKOVLEV, V. I., Leningrad Electrical
Engineering Institute of Communications imeni Professor M. A. Bonch-
Bruyevich

[Abstract] A study is presented of crosstalk distortions arising upon
diffraction of light on ultrasonic waves, and their influence on the
dynamic range of an acousticooptical device. It is assumed that the

transducer of an ultrasonic spectral analyzer receives a signal which
consists of the sum of M sine waves. Using a method of perturbations
suggested earlier for description of the diffraction of light on a
single ultrasonic sine wave grating, the authors analyzed the diffraction
of the light on a complex three-dimensional grating. An equation is
presented for the dielectric constant of the grating. Figure 1; references
6: 4 Russian, 2 Western.

[N 3-450]

HIGH-SPEED CINEMATOGRAPHY WITH LASER ILLUMINATION

KRYZHANOVSKIY, I. I., MALISHEV, L. K., NATAROVSKIY, S. N., KHVALOVSKIY,
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imeni B. Ye. Vedeneyev

[Abstract] Drawbacks to the use of laser light for high-speed cinema-
tography such as the modal structure of the light beam, the non-uniform
energy distribution over the beam cross-section and the graininess of the
resulting image due to the high coherence of the light can be overcome
by using a laser in conjunction with a lens raster, the effect of which
is equivalent to the lighting action of an extended source of coherent
light. Because of the interference phenomena involved, it is also possible
to reduce the exposure time of the photographic material and increase the
speed. A procedure is given for calculating the exposure time and photo-
graphic speed, and the derived expressions are used to compute data given
in a tabular form which indicates the laser light source, the radiation
power and wavelength, and the speed in frames per second for panchromatic
and isopanchromatic films. The slowest speed of $0.4 \cdot 10^3$ sec^{-1} is found
for the case of isopanchromatic film using an OKG-11 laser with a power
0.2 mW at a wavelength of 632.8 nm; the fastest was $3.0 \cdot 10^7$ sec^{-1}, noted
for panchromatic film where an IGLA laser is used at a power of 1 watt at
514.5 nm. An experimental check was made using the SKS-1 and VK-8 cameras
with an LG-75 laser. Speeds of up to 3,500 sec^{-1} with OCh-45 film were
attained with the SKS-1, and with the VK-8 using KN-4 motion picture film,
speeds of up to 600,000 sec^{-1}. Figures 1; references 6 (Russian).

[890-1025]

DIFFRACTION DISPERSION SYSTEMS WITH RELATIVELY CONSTANT SPECTRAL LINE CURVATURE

CHIKOV, K. N. and SHLISHEVSKIY, V. B., Leningrad Institute of Precision Mechanics and Optics, Novosibirsk Engineering Institute of Geodesy, Aerial Photography and Cartography

[Abstract] Primary factors influencing monochromator measurement precision are the constancy of the curvature of the spectral lines and the constancy of the meridianal magnification. A constant spectral line curvature involves considerable technical difficulties and is incompatible with the requirement that the meridianal magnification be constant. Simpler dispersion systems than the previous double diffraction configurations are proposed, for which the spectral line curvature varies to a much lesser extent with a specified angular dispersion, although it does not remain strictly constant in the process of scanning the spectrum. The two proposed new double diffraction systems have a meridianal magnification of unity at all wavelengths. The conclusion is drawn from the analysis of single and double diffraction autocollimation configurations that the new scheme, given equal resolving powers, yields measurement errors occasioned by spectral line curvature which are several times less than for conventional autocollimation schemes. The working spectral range of the proposed system is no less than one octave and its performance is graphically compared to that of a single diffraction configuration. Figures 4; references 6 (Russian).

PECULIARITIES OF Q-SWITCHING SPHERICAL CAVITIES WITH A ROTATING MIRROR

BERENBERG, V. A., YERMAKOV, B. A. and LYUBCHENKO, V. V.

[Abstract] The article gives the results of experimental studies on the use of rotating mirrors for Q-switching spherical cavities formed by flat mirrors and a thin lens or heat lens in ruby and neodymium glass lasers. An estimate is given of the rate of mirror rotation that maximizes the

energy in a monopulse. Curves are given for losses as dependent on misalignment. The results show that in lasers with a stable cavity, the rate of rotation of the shutter mirror that optimizes monopulse operating conditions with fixed pumping energy is inversely proportional to the focal length of the lens, and when the gain is not uniformly distributed over the cross section of the active element, the rate of rotation is considerably dependent on the misalignment of the shutter mirror and may differ by a considerable factor in different directions of misalignment. When a cylindrical illuminator with mirror reflector is used, the rate of rotation of the shutter reaches a minimum value when the axis of rotation of the mirror is perpendicular to the plane passing through the active element and the pumping lamp, and the direction of rotation is such that the axis of the cavity moves toward the pumping lamp. Figures 2; references 8: 7 Russian, 1 Western.

[7-9410]

CHECKING REFLECTION-REDUCING COATINGS ON OPTICAL SURFACES

GUREVICH, M. M.

[Abstract] An analysis is made of the process of inspecting thin interference films applied to the surface of optical components to reduce the loss of light passing through them. A method is given for measuring the reflectivities from coated surfaces in cases where the light reflected from the back surface of the inspected part cannot be eliminated. The formulas given for calculating reflectivity are considerably simplified if the part being inspected is symmetric relative to the plane perpendicular to its axis. Figure 1; references 3 (Russian).

[7-9410]

INVESTIGATION OF FIRST-ORDER REFLECTIONS IN REFLECTING MICRO-OBJECTIVES

ARLIYEVSKIY, A. G.

[Abstract] An investigation of first-order reflections in reflecting
objectives of bright-field microscopes shows that the design of the
objective is related to the coefficient of illumination. This relation-
ship is studied to develop reflecting micro-objectives with a minimum
coefficient of illumination. It is shown that aplanatic surfaces ensure
that the coefficient of illumination will be less than the relative trans-
mission of the reflex system. By using surfaces that minimize the co-
efficient of illumination, the initial optical arrangement can be determined
that is suitable for further calculation in designing a micro-objective
with reduced illumination of the image. Figures 2, references 2 (Russian).

INVESTIGATION OF FIBER-OPTICS SENSOR DESIGNS

CHIZH, I. G.

[Abstract] The author considers the use of miniature fiber-optics sensors
for picking up information from a rotating surface. Designs are examined
that provide axisymmetric distribution of irradiance of the rotor surface
and maximize utilization of the radiant flux of the illuminator. These
systems are used for photoelectric location of contrasting elements on a
reflecting rotor. A coaxial arrangement is described that makes the most
economic use of the illuminator flux and provides a maximum signal at the
output with comparatively large clearances at the input. The proposed
design is relatively insensitive to longitudinal displacements of the
rotor (in the direction of the sensor axis), which stabilizes the output
parameters of the electric signal. A mosaic design is described that can
be used in gap sensors because of high sensitivity to longitudinal dis-
placement. Figures 3; references 7: 5 Russian, 2 Western.

DESIGN OF LENS COMPENSATORS FOR CHECKING LARGE CONCAVE ASTRONOMICAL
TELESCOPE MIRRORS

PURYAYEV, D. T. and SHANDIN, N. S.

[Abstract] A method is outlined for calculating a lens compensator that
forms an aberrational system in combination with the concave telescope
mirror inspected by using this compensator. An improved design is proposed
on the basis of two-element and three-element compensators used in checking
the concave parabolic mirror of the 6-meter telescope. The compensator
is made up of two air-spaced elements: a meniscus lens with equal radii
of the spherical surfaces having the concave side toward the other element,
which is a planoconvex lens with the convex surface facing the mirror to
be inspected. The aberration of normals of the mirror is compensated by
the third-order aberration of the planoconvex lens, and residual spherical
aberration of higher order is compensated by the thick meniscus lens with
parallel path of the paraxial rays between its surfaces. It is shown
that such a compensator can be used for checking concave hyperbolic,
parabolic and elliptical mirrors without modifying the design. Computer
calculations of the effect that centering of the compensator and decenter-
ings of the lenses have on residual aberrations show that the compensator
is highly reliable, and that tolerances in manufacturing and alignment
relative to the inspected mirror are much wider than for conventional
compensators used in this way. Figures 3; references 4: 3 Russian, 1
Western.
[7-- 10]

CALCULATION OF OPTICAL BEAM COUPLERS BASED ON A SELF-FOCUSING FIBER

FILIMONOV, V. P., TSIBULYA, A. B. and CHERTOV, V. G.

[Abstract] Sections of self-focusing fibers have microlens properties
that can be used in coupling light beams between optical elements such as
LEDs and semiconductor lasers, and fiber-optics light guides. An exami-
nation is made of the problem of designing such coupling elements to

maximize the transfer of luminous energy from one matched element to another. An analysis is made of the paraxial optics of such coupling devices, and formulas are derived for designing couplers. One advantage of self-focusing fibers as couplers is that misalignment at one end can be compensated at the other end by corresponding displacement. Requirements for precision in registration of elements at both ends of the coupler can be relaxed if a comparatively long section of flexible self-focusing fiber is used. Exact registration between the light beam and the light spot is achieved in this case by bending the fiber into a prescribed curve. Self-focusing fibers are also preferable to other couplers where the coupler and the element to be matched are separated by a medium that does not have light-guide properties. Figures 4; references 8: 5 Russian, 3 Western.
[?/- ?]

PETROV, M. P., SMOLENSKIY, G. A., LEMANOV, V. V., UVAROV, A. A., ANISIMOV, A. N., KOVALEV, N. N., SOSOV, YU. M., SHAKIN, O. V., YUSHIN, N. K., YeGOROV, S. G. and FATOV, A. S.

[Abstract] The paper gives basic parameters and design data on an acousto-optical deflector developed at the Physico-Technical Research Institute of the Soviet Academy of Sciences and by the Special Design Office of this institute. The device is made for scanning a laser beam in holographic memory devices and other systems of optical data processing with arbitrary beam addressing. The deflector includes an acousto-optical cell, a control unit and an optical system. The device operates on the principle of Bragg diffraction of light by an elastic wave propagating in the acousto-optical cell, the angles of incidence and deflection of light being determined by the frequency of ultrasound in accordance with the Bragg formula. Beam scanning is controlled by varying the ultrasonic frequency in the control unit. Basic parameters of the deflector: Rayleigh resolution of 300 positions, input beam diameter 4 mm, speed 7 μs, efficiency 50% at an electric control power of 1 W, central frequency 130 MHz. The deflector uses a telescopic system that produces a beam with divergence of no more than 40". Figures 3; references 3: 1 Russian, 2 Western.
[?/- ?]

A THREE-LAYER REFLECTION-REDUCING COATING WITH EXPANDED RANGE OF FIELD
BRIGHTENING

SHIKHOV, V. A. and PRIDATKO, G. D.

[Abstract] Research is done to optimize the two indices of refraction
n_1 and n_2 in a three-layer reflection-reducing coating of the type $0.25\lambda_0$-
$0.5\lambda_0$-$0.25\lambda_0$ with $n_s < n_3 < n_2 > n_1 > n_0$; $n_s < n_1$; $n_3 < \sqrt[4]{n_s}$; $n_0 = 1$, where n_s
is the index of refraction of the substrate. Nomograms are presented for
calculating the parameters of such layers for values of n_1 of 1.38 and 1.45.
The indices of refraction are optimized for a reflection-reducing coating
that maximizes the width of the field-brightening region for glasses with
n_s of 1.52-1.72. It is shown that a two-layer coating with half-wave
underlayer on glass with an index of refraction of $n_1 + \frac{R_0}{250}$ or more (where
R_0 is the average reflectivity in percent) provides a wide range of field
brightening with residual reflection of 0.5% or less. Figures 4; references
8: 6 Russian, 2 Western.

[107-110]

HOLOGRAPHIC EQUIVALENT OF A SCREEN WITH A REGULAR SYSTEM OF APERTURES

FOLOMEYEVA, M. I., SUBBOTIN, F. M., MAKSIMOVA, G. A., deceased, and
YEVMENOVA, G. V.

[Abstract] One of the greatest disadvantages of opaque aperture matrices
for producing a system of coherent beams is high losses of light. For
example a matrix with apertures of 20 μm spaced 50 μm apart has a trans-
mission of only about 5%. To overcome this disadvantage, the authors
consider a method of producing a multiple-beam source by holographing the
wave front transmitted through an actual screen with aperture system. A
comparison is made between the actual screen and the holographic equivalent
with respect to such properties as self-reproduction, multiplication, and
diffraction production of a system of principal maxima separated by
secondary maxima in the far zone. Holographic screens are produced on
layers of FP-383 and RN-7 acid resist and shellac sensitized with chromates.

The resultant holograms make effective aperture matrices for producing coherent beam systems even when recorded on media with a high noise level. Since the diffraction efficiency can be as high as tens of percent, such holographic equivalents are superior to opaque aperture matrices with respect to reduced light loss. The hologram on FP-383 acid resist had a diffraction efficiency of 12%. References 4: 1 Russian, 3 Western. [207-4010]

STUPAK, N. A.

[Abstract] A high-resolution high-speed scanning system is analyzed which includes a laser beam and a multifacet mirror drum. Tracking the center of a drum facet eliminates shading and thus improves the overall efficiency. A tracking sweep is achieved ideally by appropriate shifting of the beam with the center of a facet in synchronism with the drum rotation. In practice this has not yet been achieved, mainly because of variables in a real system and imprecise synchronization of independently moving system components. Several schemes approaching such a performance have been developed, however, with either lenses or curved mirrors for sweeping and with either parallel or oblique shifting of the beam. The laser beam in these devices has a small angular divergence and does not become defocused, when optical axes of the sweeping elements are parallel to their common axis of rotation. Figures 3; references 4: 1 Russian, 3 Western. [207-2412]

MODEL SP-129 REFRACTOMETER FOR THE ULTRAVIOLET RANGE OF THE SPECTRUM

BAKHSHIYEVA, G. F., GRADUSOVA, S. A. and STEPIN, YU. A.

[Abstract] An instrument has been invented and built by the authors at
the State Institute of Optics imeni S. I. Vavilov for ultraviolet measure-
ment of optical properties of materials. This instrument, the SP-129
refractometer, is designed for measuring the refractive index and the
dispersion index of materials transparent to ultraviolet light at wave-
lengths within the 100-500 nm range. Its essential operating components
include a spectrograph in a hermetically sealed case, a low-voltage flash-
discharge chamber, a roughing vacuum pump and a diffusion pump. The
optical part consists of a light source with a protective glass shield,
a condensing lens, a shutter, an autocollimator (a semitransparent plane
mirror, a cubic twin prism sending one beam through a grating to an ocular
and receiving another beam from a lamp through a condensing lens and
another grating), a spherical mirror, a reference and measuring prism pair,
a plane mirror, another spherical mirror, and a photographic film or plate.
The instrument operates by the differential goniometric method. Its
accuracy has been checked with a CaF$_2$ crystal of well known properties
and, with the proper selection of components, found to equal that of a
1"-goniometer. Its performance has also been tested at several wavelengths
and checked against that of other existing instruments (Zeiss) for cali-
bration. Simpler versions of this instrument, without vacuum, as accurate
but for a narrower range of the spectrum appear to be feasible. Figures
4; tables 4; references 5: 2 Russian, 3 Western.
[3 - 4157

SEVERAL MECHANISMS OF REACTIONS OF PHOTORECOMBINATION RADIATION UPON
COLLISION OF ATOMS

KURMANALIYEVA, G. D., SHLYAPNIKOV, G. V. and SHMATOV, I. P.

[Abstract] The example of recombination of halogen atoms is used to study
four mechanisms: direct photorecombination, photorecombination through

the formation of quasidiscrete states of molecules in a field of effective potential energy, the mechanism of inverse predissociation and photo-recombination upon trinary collisions. The conditions under which various mechanisms are dominant are determined (temperature range, gas densities). The results are represented in a form convenient for use for analysis of experimental data on the photorecombination of halogen atoms. Figures 3; references 19: 9 Russian, 10 Western.

[. . -. 50]

SELECTIVE LASER EXCITATION OF THE LUMINESCENCE OF Sm^{3+} IONS IN LANTHANUM-ALUMINOSILICATE GLASS

BASIYEV. T. T., BORIK, M. A., VORON'KO, YU. K., OSIKO, V. V. and FEDOROV, V. S.

[Abstract] A study is made of high temperature lanthanum-aluminosilicate glass ($0.19 \ La_2O_3 \times 0.27 \ Al_2O_3 \cdot 0.54 \ SiO_2$, activated with 1.2 wt.% Sm_2O_3), recently synthesized in the authors' laboratory by direct high frequency heating in a "cold" container. The method of selective laser excitation of luminescence is used to study the spectral properties of the rare earth ions in the structure of the glass. The luminescent spectra of the Sm^{3+} ions in the glass upon nonselective excitation by an incandescent lamp plus filter and laser excitation at 562, 564 and 566 nm are presented. The study of the structure of Stark splitting of Sm^{3+} in the glass by selective laser excitation indicates that there are no microphases with greatly different symmetry of surroundings containing an activator. Figures 3; references 9: 7 Russian, 2 Western.

[. . -. 50]

25

CHROMATIC PROPERTIES OF PROFILED ZONE PLATES

VERESHCHAGIN, V. V. and LOPATIN, A. I.

[Abstract] Zone plates consisting of alternating transparent and non-
transparent rings have been known since the late 1800's. Though not as
widely used as diffraction gratings, they can be quite useful. The
primary factor preventing the use of zone plates as a focusing system is
the low focusing coefficient. However, this coefficient can be increased
almost to 100% by profiling the plates. It is the purpose of this
article to determine the chromatic properties of such profiled zone
plates. A theory of reflective profiled zone plates is constructed,
which extends to transmissive profiled zone plates if the profile of
the zones is changed. Figures 4; references 7: 5 Russian, 2 Western.
[≈ ≈ 30]

STUDY OF IR-BAND MICROWAVE GUIDES WITH A SUPPORTING LAYER OF CHALCOGENIDE
GLASS

GUDZENKO, A. I. and TERICHEV, V. F.

[Abstract] The authors have studied As-Se chalcogenide glass for purposes
of integral optics in the middle IR-band. This glass is used as the
supporting layer for a thin-film microwave guide on a substrate of single-
crystalline BaF_2. However, the wave guide has significant losses (on the
order of 3 dB/cm), which stimulated a search for other substrates. Poly-
crystalline ZnS and ZnSe have been found to be suitable substrates for
this purpose. Figure 1; references 4: 3 Russian, 1 Western.
[≈ ≈ 30]

IGNITION OF A VACUUM ARC IN STATIONARY METAL PLASMA SOURCES FROM A
SELF-CONTAINED PLASMA INJECTOR

AKSENOV, I. I. and BELOUS, A. A.

[Abstract] A noncontact method of vacuum arc ignition is described in
which a dense plasma jet from a pulse injector is directed to the non-
working side of the cathode, where an electric field has been set up with
intensity exceeding the field strength in the working part of the main
arc gap. The resultant cathode spot is moved from the lateral surface
to the working surface by a magnetic field. Two versions of a stationary
metal plasma source triggered by this principle are described. The two
designs differ in the method of holding the cathode spot on the lateral
surface of the cathode. Figures 2; references 6: 5 Russian, 1 Western.
[F75-0010]

USING A HIGH-SPEED OSCILLOSCOPE TO STUDY A NEODYMIUM GLASS SUBNANOSECOND
PULSE LASER

BERKOVSKIY, A. G., BYKOVSKIY, N. YE., GUBANOV, YU. I., GUSEV, N. V.,
PLETNEV, N. V., SENATSKIY, YU. V., SKLIZKOV, G. V., SUSHCHENKO, A. N.
and TARASOV, R. P., Physics Institute, Academy of Sciences USSR, Moscow

[Abstract] The paper describes a technique for studying the time character-
istics of subnanosecond pulse lasers based on neodymium glass with periodic
Q-switching. The method is based on using high-speed oscilloscopic regis-
tration with mathematical processing of the results. Registration of the
emission from a self-mode-locked laser by using the SDF-12 photocell and
an oscilloscope shows pulses with half-height duration of no more than
170 ps. The photocell and oscilloscope were then used to study the Q-
switched laser, giving a pulse duration of about 600 ps. Pulse broadening
and envelope modulation were observed with misalignment of the cavity base
relative to the optimum position. Changes in pulse shape were also ob-
served. These are due to nonlinear losses in the cavity. By using a
mathematical method of signal reconstruction, the effective resolution

of the registration channel was increased to about 60 ps, enabling more precise determination of the fine structure of the recorded pulses. The authors thank N. G. Basov, O. N. Krokhin, Yu. K. Slavnov and S. A. Khromov for interest and support of the work, and also M. I. Shibakov for doing the computer calculations. Figures 6; references 9 (Russian).

[75-0010]

A SYSTEM FOR LAMB-SHIFT AUTOMATIC FREQUENCY CONTROL OF Ne-Ne LASER EMISSION

KHANOV, V. A., Institute of Automation and Electrometry, Siberian Department, Academy of Sciences USSR, Novosibirsk

[Abstract] This is a brief summary of a deposited article: VINITI No 3879- 78 dep. A circuit is described that provides Lamb-shift afc of He-Ne laser radiation to ensure precision characteristics without monitoring by the operator over a prolonged measurement cycle under conditions of broad changes in air parameters and high vibration levels. The afc circuit is an optimalizing control system that automatically adjusts the laser emission frequency to the center of the Lamb-shift. The circuit is made with transistors and ICs and is accommodated on a single circuit board measuring 280 x 120 mm. Figure 1; references 2 (Russian).

[75-0010]

A MULTICHANNEL PHOTOSENSOR FOR SPACE-TIME RECORDING OF AN OPTICAL SIGNAL

BUBNOV, I. A.

[Abstract] Photosensor matrices are used to register an optical signal with space-time resolution. The signals from each of the cells are coupled out to their own recording device, such as an oscilloscope. Commutation of signals from the photocells to a single oscilloscope input is often used. In this case the number of photosensors depends on the

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method of commutation. This paper describes a photosensor for consecutive readout of signals from 15 channels in a cycle, eight times during an investigated process in equally spaced time intervals. This device can record processes that last from tenths of a microsecond to 1.5 milliseconds on the screen of a single-beam oscilloscope. The unit has a spectral sensitivity range of 400-1800 nm, and the readout cycle for 15 channels lasts 4.5 µs. The time interval between cycles can be controlled over a range of 10-200 µs. Nonlinearity of the amplitude response is about 5%. The block diagram of the photosensor is given, and also a schematic diagram of one channel. Figures 3; references 5: 3 Russian, 2 Western.
[15-8181]

SYNCHRONIZING OPERATION OF THE LG-36A LASER WITH THE SFR-2M CAMERA

GRINYUK, S. I. and LISICHENKO, V. I., Dnepropetrovsk Division of the Institute of Mechanics

[Abstract] An electronic system is described for synchronizing operation of an LG-36A laser with an SFR-2M streak camera. The turn counter of the camera mirror produces a pulse that ignites the laser tube, quenches it, and initiates the process to be studied. Delay lines are used to control the interval between pulse quenching and initiation of the process to be studied. A time chart and block diagram are given to show how the synchronization process is organized. Figures 2; reference 1 (Russian).
[15-8181]

UDC 621.382.232

A PHOTOSENSOR HEAD FOR LASER EMISSION ON 10.6 μm

ZELENOV, A. A., LASHKOV, V. I. and SEMENOV, YE. P.

[Abstract] The device described in this note is designed for registration
of monopulse or modulated cw emission of a CO_2 laser on an oscilloscope.
The device has a sensitivity of 1 mW and can register pulses in a duration
range of 0.05-1000 μs with rise time of 0.02 μs and fall time of 0.03 μs.
The dynamic range of the output signal is 0.5 V, and the output impedance
is 51 Ω at the end of the connecting cable. Supply voltage is 10 V, and
the instrument draws current of 15 mA. The photoresistor is cooled with
liquid nitrogen. Operating time before recharging is 16 hours. The unit
measures 220 x 120 mm and weighs 1 kg. Figure 1.
[9-9510]

USSR   UDC 65.015.13

TECHNOLOGICAL NETWORKS AND THE SYNTHESIS OF AUTOMATION CONTROL SYSTEMS

POLYANSKIY, A. A. and NEIZVESTNYKH, A. G., Volgograd Polytechnic Institute

[Abstract] In the development of technological processes for the machining of components in machine building and instrument making allowance must be made for a large number of factors affecting the quality of machining. In this connection a method for the analysis of technological processes based on representing the individual processes by means of tree diagrams is considered. This makes possible the use of computers to plan the processes by identifying each process with a separate graph analogous to that of a finite automaton. It is shown that an automaton controlling the course of a discrete technological process can be synthesized on the basis of the breakdown of the control system into components with separate synthesis of each component and of the connections between components, working solely with matrices and graphs, which simplifies the synthesis of complex control systems and makes it possible to use computers for this purpose. As considered here, the method for determining optimal or near-optimal technological processes also is sufficiently formalized and can be programmed on a computer. Figures 4; references 4 (Russian).
[314-1979]

USSR   UDC 631.171

A COMPREHENSIVE PROGRAM FOR THE MECHANIZATION OF LABOR-INTENSIVE OPERATIONS

IVANOV, YE. YE. and BELYAKOVICH, A. M.

[Abstract] The level of mechanization of animal husbandry, poultry raising, and feed producing operations is steadily rising, having reached 80.3% in 1978. The Mogilev Project-Design Technology Institute of Automation and Mechanization (PKTIAM) has been appointed by the Ministry of Livestock Machine Building as the organization responsible for coordinating the program for the increase in the technical level and the acceleration of the development and introduction of projects for overall mechanization and automation of loading, unloading, transporting, and warehousing operations during the next five-year plan. In this connection, the PKTIAM is developing a unified system of machines and mechanisms for the mechanization of loading, unloading, transporting, and warehousing operations,

for the machine-building enterprises serving the needs of animal husbandry, poultry raising, and feed production. The accomplishments so far include the introduction of stacking cranes, the standardization of packing, the introduction of highly productive semi-automatic and automatic loaders, and a broader use of all sorts of conveyers as well as increased automation of warehousing operations.

[9-13᠀]

OVAKIMOV, A. G., Moscow

[Abstract] Equations of motion are written and solved for a general model of a manipulator: both the structure of its drive and its kinematic configuration are arbitrary; the requisite number of motors can be placed in any member (including the support), and the motion is transmitted from the motors through gear transmissions to all or any portion of the subsequent links in the manipulator. This model encompasses extremely complex drive configurations for such electromechanical manipulators as the "MEM," "400" and the "Universal-50" and allows for making the transition from one drive configuration to another by changing only the initial data. It is assumed that the manipulator is a spatial kinematic network with an arbitrary number of members joined by rotary and reciprocating pairs. A group of matrices is used to describe the drive configuration, the kinematics and the arrangement of the transmissions in the members of the manipulator. General formulas are derived to compute all of the coefficients of these equations and the general solution allows for the derivation of a computer algorithm. The equations were derived using a method based on the use of velocity analogs and kinetic moment analogs in the general dynamics equation, an approach which proved to be preferable to the method of Lagrange equations proposed in earlier literature. Results of running previous algorithms and the ones derived here in FORTRAN IV language to solve the problem of manipulator motion yielded identical results. Figure 1; references 6 (Russian).

[847-H2᠀]

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ELASTIC TOOLS FOR MACHINING OPTICAL COMPONENTS WITH NON-CIRCULAR CYLINDRICAL
SURFACES

SOSNOVA, N. K.

[Abstract] Mathematical expressions are given for calculating the profiles
of elastic tools used in machining non-circular cylindrical surfaces. The
tool is an elastic plate of constant thickness and variable length with a
fitting in the center for fastening in the machine tool. The edges of the
plate are made to conform to a special contour related to the given non-
circular surface by the expression $b(x) = f[q, E, l, h, y(x)]$, where q is
the distributed load, l, h are respectively the width and thickness of the
tool, and $y(x)$ is the given equation of the profile. Methods of making
such tools are considered, and an example is given of use of such a tool
for machining acylindrical surface $y = 0.0001x^2$. Figures 2; references
4 (Russian).

THE MOMENT OF FORCES OF INERTIA DURING COMPLEX MOVEMENT OF SOLID BODIES

YUDIN, V. I., Leningrad Polytechnical Institute

[Abstract] An analysis is made of the structural systems of two types
of industrial robots: those in which the components can perform both
rotary and translational motions such as the UNIMATE; and those in which
the components can perform only rotary motions, such as the COAT-A-MATIC.
The purpose is to calculate the moment of forces of the inertia of the
system relative to a nonmoving point around which the components rotate.
The simplified system studied consists of two components, one of which
rotates about the nonmoving point of reference, while the other performs
translational motion, sliding in and out of a slot, whose center line
includes the nonmoving point. The moment of forces of inertia is also
found relative to the nonmoving point for a more complex mechanism, con-
sisting of three straight members and two articulated points, joined
together to form a three-member arm, one end of which is the nonmoving
point. Figures 3; references 2 (Russian).

UDC 539.311

NUMBER OF SOLUTIONS TO BOUNDARY-VALUE PROBLEMS IN THE NONLINEAR THEORY OF SHELLS

KLIMOV, V. S., Yaroslavl State University

[Abstract] Nonlinear problems are characterized by the existence of many
solutions to the corresponding equations. Here two nonlinear boundary-
value problems are considered, one in the theory of shells and one in the
Ginsburg-Landau theory of superconductivity. The number of general
solutions in each case is estimated more precisely than has been heretofore,
on the basis of theorems stipulating the conditions under which there will
always exist at least three of them. These general solutions can be
shown to be classical, i.e., differentiable a sufficient number of times.
The author thanks M. A. KRASNOSEL'SKIY for the suggestions on improving
the manuscript. The article was presented by academician A. YU. ISHLINSKIY
on 15 Jan 79. References 9: 6 Russian, 3 Western.
[P79-4127]

UDC 629.7.024:539.3

DEFORMATION OF THIN SHELLS LOADED VIA ELASTIC ONE-DIMENSIONAL STIFFENERS

ANTUF'YEV, B. A. and SHKLYARCHUK, F. N.

[Abstract] The contact problem of the deformation of a thin elastic shell
having a nonnegative gaussian curvature is considered for shells loaded
via an elastic one-dimensional--that is, extended in a single direction--
stiffener positioned in one of the main curvature planes of the shell.
The length of the stiffener is much shorter than that of the radii of
main curvatures of the shell, and hence the curvature of the stiffener
is disregarded, since the stiffener is regarded as an elastic beam subject
to flexural stresses alone. A transverse load is applied to the stiffener
in the plane normal to the median surface of the shell. Spherical shells
with elastic and rigid stiffeners are considered as examples. A corres-
ponding system of integral equations is derived, and is then solved by
the Bubnov-Galerkin method to form a closed symmetrical system of linear
algebraic equations. It is shown that convergence of the solution is better
for the elastic stiffener than for the rigid stiffener. Figures 4;
references 5 (Russian).
[P79-1307]

STABILITY OF CYLINDRICAL PANELS UNDER HYDROSTATIC PRESSURE

ASTAKHOV, M. V. and YERSHOV, V. V.

[Abstract] The stability of a cylindrical panel hinged along the straight
edges and exposed to hydrostatic pressure is investigated. The boundary
eigenvalue problem is solved by the method of perturbation theory. Ap-
proximate formulas for the eigenfunction and eigenvalue in dimensionless
terms are derived on proceeding from the concept of the standard functional
Hilbert space element. For the case of hydrostatic loading considered,
the eigenvalue of the unperturbed boundary value problem is shown to
represent the upper estimate of the eigenvalue of the perturbed boundary
value problem. It is also shown that for the converging series considered
any sum of a finite number of terms of that series provides the lower
estimate of the boundary-problem eigenvalue. References 4 (Russian).

LOCAL STRESSES IN A CYLINDRICAL SHELL LOADED OVER AN ELLIPTICAL AREA

OL'SHANSKIY, V. P.

[Abstract] The distribution of local stresses in a cylindrical shell upon
the action of a load applied to an elliptical area is investigated: such
a form of the loading zone occurs at contact between a cylinder and various
surfaces and is hence often encountered in practice. In the calculations
it is assumed that the region of action of the external normal load is
sufficiently distant from the edge of the shell, thus making it possible
to disregard the effect of boundary conditions on the field of local
stresses. The problem so stated is solved by two-dimensional Fourier
transformation here used to derive the distribution of moments and stresses
in the shell. Simple asymptotic formulas for estimating the bending
moments at the center of the elliptical and rectangular areas are pre-
sented. The effect of the pattern of load distribution and of the form
of load area on the magnitude of flexural stresses is investigated.
References 4 (Russian).

ZERO-MOMENT AXISYMMETRIC DEFORMATION OF THINWALLED CYLINDRICAL SHELLS

PASHKEVICH, A. G., KASHIRIN, M. F. and OREKHOV, A. V.

[Abstract] The axisymmetric problem of the deformation of cylindrical
shells by an axial compressive stress is considered here with respect
to the processes of swaging and coiling of thinwalled pipe. Analytic
formulas for determining the required straining pressure and the possi-
bilities for change in shape are derived on the premise of absence of
axial buckling of the shell. The theoretical formulas are found to be
in agreement with experiment correct to $\pm 10\%$ in most cases. The more
marked deviations in certain cases (such as those of pipe manufactured
from D16T, VT1, and OT4 alloys) are due to the fact that the potential
of the processes is exhausted not only by buckling but also by failure
of the pipe edge upon exhaustion of its loadbearing capacity in the
stress transfer zone. Figures 3; references 6 (Russian).
[PH-IPR]

OSCILLATIONS OF STRUCTURALLY COMPLEX RODS WITH LENGTHWISE VARIABLE
PROPERTIES

STANKEVICH, A. I., candidate of technical sciences, TRAPEZIN, I. I.,
doctor of technical sciences, Moscow Aviation Institute

[Abstract] High frequency longitudinal waves propagate in a rod. The
stiffness, mass and attenuation factor of the rod vary along its length.
A parameter characterizing wave attenuation in the rod is defined and
the influence of this parameter on the oscillations of the rod is shown
to be insignificant. The analytical expressions derived for rod oscil-
lations are applied to the case of a rod subjected to two concentrated
random forces to determine the statistical characteristics of the
vibrational accelerations of points in the rod for the cases where: 1)
the external forces are not correlated; 2) there is a strict correlation
between the forces and 3) the form of the cross correlation function
between them is specified. The dispersion of the vibrational accelerations

along the length of the rod is plotted graphically and the analysis of the
curves shows that accounting for the correlation between the excitation
forces has an effect on the level of the vibrational accelerations only
in the region directly contiguous with the region where the external loads
are applied, while in a region remote from that where the forces are
applied, taking the correlation functions into account has practically
no influence on the results of the calculations. Figures 2; references
3 (Russian).

[9-025]

THE DETERMINATION OF THE MAXIMUM TRACTIONAL MOMENT OF A DISK FOR THE
CASE OF VIBRATIONAL ROTATION

SMOLENTSEV, YU. A., KHACHIYAN, G. B., candidates of technical sciences,
BULGAKOV, G. V., assistant and IVANOV, O. N., doctor of technical sciences,
Moscow Chemical Machine Construction Institute

[Abstract] Products are transported in semi-automatic devices for vibrational
chemical processing by a transporting disk, which rotates in conical guides
about the vertical axis with the action of a vibrating base. The rotations
of the disk with respect to the base are executed with two instantaneous
stops during each period of the base oscillations. The disk forces acting
on the products being transported produce a moment with respect to the
axis of rotation which is called the tractional moment. The maximum
tractional moment is that moment during which the average relative angular
velocity of the disk over one oscillation period of the base is equal to
zero because the disk rotation angles in positive and negative directions
with respect to the base are equal in magnitude. Analytical expressions
are derived for the maximum tractional moment of a disk and applied to a
digital computer analysis of a disk weighing 15.7 N with a radius of
0.096 m. The maximum tractional moment of the disk is shown as a function
of various parameters and the digital computer studies show that this
moment reaches a maximum value where the phase shift angle between the
vertical and torsional vibrations of the base is 80°. Figures 3;
references 2 (Russian).

[9-011]

RESONANT SELF-OSCILLATIONS OF A CONTROLLED SOLID

GANIYEV, R. F. and MAKARENKO, A. I., Kiev

[Abstract] A solid body moves about a center of mass in a cartesian system
of coordinates which rotates at a constant angular velocity. The body is
rigidly tied to a system of central cartesian coordinates and dynamic
Euler equations are used to describe the motion of the body in terms of
the moments of inertia of the body, the projections of the angular velocity
vector of the body onto its system of coordinates, the projections of the
external moment vectors and the projections of the controlling moment
vectors. Only gravity is considered in the external moments acting on
the body and it is assumed that one of the control moments is described
by a step function while the remaining ones are linear functions of the
control signals. Complex analytical expressions are derived for the
resonance states of the system and it is shown that a mode of plane self-
oscillations is unstable where resonance relationships are observed
between the resonant frequencies of the system and the self-oscillation
frequency. The regions of instability are shown graphically for cases
of subharmonic and primary resonances. The existence of self-oscillations
means that when resonances are observed between the control channel
frequencies and the self-oscillation frequency, spatial self-oscillations
are excited in the body, the presence of which leads to a disruption in
the orientation mode of the solid body. The results derived can find
application in the design of stabilization and orientation systems for
various mechanisms in such fields as gyroscope and robot engineering.
Figures 3; references 4 (Russian).

$[7 - 27]$

NUMERICAL ANALYSIS OF THE ELASTIC-PLASTIC DEFORMATION OF SHELLS WITH
CURVED APERTURES UNDER PULSED LOADING

BAZHENOV, V. G., UGODCHIKOV, A. G. and SHINKARENKO, A. P., Gori'kiy State
University

[Abstract] A study is made of a numerical method for solution of geo-
metrically and physically nonlinear problems relating to the dynamics of

Timoshenko shells with curved contours and apertures. The method is based
on a divergent system for approximation of partial derivatives of the
spatial coordinates and an explicit scheme for integration of the equations
of motion with respect to time. A variational-difference method of
solution is suggested. An ALGOL program, running on a BESM-6 computer,
was used to calculate the dynamic elastic-plastic deformation of a
cylindrical panel with a circular aperture loaded by a rectangular pulse
of external pressure P = 10 MPA, 100 μs in duration. Figures 5; references
3 (Russian).

/315-150/

DEFORMATION OF RODS BY AN EXTERNAL MAGNETIC FIELD

AGRANOVICH, Z. S. and DEREVYANKO, N. I., Khar'kov State University;
Khar'kov Institute of Construction Engineering

[Abstract] A study is made of elastic prismatic rods of thermomagnetic
materials with or without initial magnetization, interacting with an
external static magnetic field. The influence of the elastic deformation
of the rods on the magnetic field is considered negligible, which allows
the problem of magnetoelasticity to be divided into independently and
sequentially solvable magnetostatic and elastic problems. The magneto-
static problem is presumed solved, i.e. the magnetic fields inside and
outside the rod are assumed known, and are used to calculate the
pondermotive surface and body forces in the rod, as well as the body
moments if an initial magnetic field is present or the rod is magnetically
anisotropic. References 6 (Russian).

/315-150/

THE INFLUENCE OF THE POISSON RATIO ON THE NORMAL MODES OF OSCILLATIONS
OF SPHERICAL SHELLS

LIZAREV, A. D., SHPAKOVA, S. G. and ROSTANINA, N. B., Institute of
Mechanics of Metal-Polymer Systems, BSSR Academy of Sciences, Gomel';
Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] The function $\omega = \omega(\nu)$ is studied, where ω is the normal
mode of a closed spherical shell in zero-torque oscillation, ν is the
Poisson ratio, $0 \leqslant \nu \leqslant 0.5$. The example used is the solution of the problem
of the natural oscillations of a spherical shell with a rigidly clamped
edge, $R/h = 50$, 100 and ∞ , $m = 0$, 1, 2, for a broad range of variation
of the aperture angle. Since a change in ν influences the normal modes
of oscillations of the spherical shell at least as much as the ratio R/h,
both parameters must be considered in determining normal modes. Figures 2;
references 12: 9 Russian, 3 Western.
[13-59]

AN ORTHOTROPIC CYLINDRICAL SHELL UNDER A LOCAL LOAD

NERUBAYLO, B. V., Podol'sk

[Abstract] The complete state of stress of an infinitely long orthotropic
cylindrical shell under a local radial load is synthesized from appropriate
combinations of three elementary components: principal state, flexural
state and edge effect around any one load zone. The load is represented
by a Fourier series in the circumferential direction and a Fourier integral
in the longitudinal direction, with the origin of coordinates at the center
of a load zone. The resolvent equation involving only radial displacement,
normal forces and bending moments is solved approximately by a method which
lends itself easily to numerical evaluation. Depending on a high or low
variability index, equations of elementary states are combined so as to
ensure the minimum asymptotic error and to eliminate the eighth-order
equation in both coordinates. The method is applied to the special case
of a force load, either concentrated or widely distributed. The results

indicate the feasibility of such a synthesis from elementary states rather than according to the theory of shells with a high variability index. Figures 2; references 9 (Russian).

/31 - 41/

NUMERICAL ANALYSIS OF THE STATE OF STRESS OF A CYLINDRICAL SHELL WITH A CIRCULAR HOLE

GARASHCHUK, I. N. and CHERNYSHENKO, I. S., Institute of Mechanics, Academy of Sciences of the Ukrainian SSR, Kiev

[Abstract] An isotropic thin circular cylindrical shell with a circular hole in the lateral surface is considered under a static surface load with cartesian components. The plane state of stress is determined from the system of partial differential equations of elastic equilibrium in semigeodetic coordinates, with the origin at the center of the hole. The solution reduces to calculation of the displacement vector in these coordinates for the median shell surface, which is done by numerical integration. The corresponding finite-difference equations are solved according to a special case of the implicit scheme. The algorithm is one of an iteration process, to be terminated when the discrepancy has been reduced to the allowable magnitude. This algorithm has been programmed in FORTRAN for a BESM-6 high-speed computer. Typical results are shown for a shell with a rigidly clamped or a hinge-supported edge, also for a shell with a rigid washer soldered into the hole. Figures 3; references 9 (Russian).

/31 - 41/

FORCED VIBRATIONS OF A RIBBED CONICAL SHELL UNDER A HARMONIC LOAD

SKOSARENKO, YU. V., Institute of Mechanics, Academy of Sciences of the
Ukrainian SSR

[Abstract] Forced vibrations of a thin conical shell with meridional ribs
under a harmonic load are analyzed as a linear problem. The variational
equation of displacements is solved by application of the Hamilton-
Ostrogradskiy principle, with transverse shear according to Timoshenko
as well as discrete spacing of ribs and rotational inertia of shell
elements taken into account. For the specific case of a freely supported
frustum under an axisymmetric harmonic load, as an example, the differential
equation with appropriate boundary conditions is solved by the general
Bubnov-Galerkin method involving expansion into a double trigonometric
series and, after integration, reduction to eventually a finite approximate
system of linear algebraic equations. The algorithm has been programmed
for an M4030 computer. The numerical results for typical shells indicate
that a cone is less rigid than a cylinder of the same height and an
equivalent reinforcement whose diameter is equal to the mean diameter
of the cone. Accordingly, while the magnitudes of displacements and
bending moments increase, the first resonance frequency becomes lower
with increasing taper. Figures 4; tables 2; references 6 (Russian).
[314-2415]

LARGE STRAINS IN RINGS OF A MATERIAL WITH PLASTICITY

KOSORUKOV, S. N., Chelyabinsk

[Abstract] Under consideration is a thin initially circular ring of a
rigid-plastic material with hardening, loaded by two opposing diametral
forces. The resulting finite strains in such a ring, with negligible
hoop stresses, are calculated according to the theory of beam flexure.
The fundamental equation of equilibrium in the deformed state reduces
to an equation identical to that of a pendulum in a gravitational field.
Since an analytical solution for the appropriate boundary conditions

involves transcendental equations with elliptic integral functions, an
algorithm of a numerical solution has been constructed. Here typical
results obtained with the aid of a small MIR computer are checked against
and found to be close to results obtained using tables of elliptic
integrals. The method is applicable to materials between the extremes
of an elastic and a rigid-(ideally)plastic one but not to an ideally
plastic one. Figures 4; references 4: 1 Russian, 1 German, 2 Western.
/31o-415/

EFFECT OF ORTHOTROPY ON THE STRESS DISTRIBUTION NEAR A HOLE IN A CONICAL
SHELL

LUGOVOY, P. Z., Institute of Geophysics, Academy of Sciences of the
Ukrainian SSR, Kiev

[Abstract] The effect of orthotropy on the stress distribution around a
large circular hole in a conical shell is analyzed with the use of two
systems of orthogonal coordinates: one with the origin at the vertex
of the cone and one with the origin at the center of the hole. The system
of three differential equations relating the displacements to strains
and curvatures reduces to a single variational equation with one double-
integral term and one single-integral term. A solution is shown for a
conical shell with a medium-size hole far from the vertex, where torsion
produces a zero-moment principal state of stress, without forces acting
at the contour of the hole. Figures 2; references 5 (Russian).
/31-415/

EFFECT OF CERTAIN PROPERTIES OF A COMPOSITE MATERIAL ON THE DYNAMIC
BEHAVIOR OF CYLINDRICAL SHELLS

KUPTSOV, V. I., Institute of Mechanics, Academy of Sciences of the
Ukrainian SSR, Kiev

[Abstract] Transverse natural vibrations of an orthotropic thin cylindrical
cantilever shell with a circular cross section and of a composite material
are analyzed, this material being viscoelastic owing to the binder and
its fibers neither bending, slipping, or breaking where adhesion to the
binder is lost. An upper estimate of the natural frequency is found by
application of the Volterra principle and accounting only for the rheonomic
effects on the transverse shear modulus, all other moduli representing
elastic characteristics. The fundamental and harmonics up to the sixths
have been calculated by a numerical solution for specific values of
shell parameters. The frequencies are not more than 12% lower than those
based on an elastic solution. Tables 1; references 7 (Russian).
[11 - 412]

STUDY OF THE STRESS-STRAIN STATE OF COMPOUND SHELL STRUCTURES

GAVELYA, S. P. and SYSOYEV, YU. A., Kiev Technological Institute for
Light Industry

[Abstract] An analysis is made of a model of a folded structure of
cylindrical shape, formed by connecting a sequence of curved panels,
alternating at two different distances from the center point, by radial
plates, so that the cross section of the structure looks like a gear
wheel. When an arbitrary external load is applied, it is necessary to
calculate the stress and strain of a three-element section, due to the
asymmetry of deformation of the walls. As a second, more complex example,
the hull of a catamaran is studied, consisting of two box sections con-
nected by a horizontal panel parallel to the top walls of the two box
sections. Equations are presented which can be run on a Minsk-32
computer with no peripheral storage. Eleven minutes of machine time are

required for calculation of each of the 8 harmonics considered. Consideration of additional harmonics yields not over 1.5% refinement of calculation results. Figures 3; references 5 (Russian).

[317-6510]

A SELF-ADJUSTING MULTISTEP PROCESS FOR THE DESIGN OF FLEXIBLE SHELLS

KANTOR, B. YA. and BAYEVSKAYA, G. D., Institute of Machine Building Problems, Ukrainian Academy of Sciences, Khar'kov

[Abstract] The use of self-adjusting processes helps to decrease the computational effort required to study geometrically nonlinear shells of revolution by allowing a larger calculation step to be taken. Development of an analogous process for the design of flexible shells, based on a mixed-type variational equation, would be quite interesting. This work derives a variational equation of this type corresponding to a self-adjusting first order process. The rate of its convergence is studied numerically on the example of solution of problems of stability of a cylindrical and a smooth spherical shell. Use of the equation with its correcting term helps to increase the accuracy of iterative solutions while significantly reducing the number of iterative steps required by allowing the increment to be significantly larger. Figures 2; references 6: 2 Russian, 4 Western.

[317-6510]

STABILITY OF ORTHOTROPIC CYLINDRICAL SANDWICH SHELLS WITH DISCRETE SUPPORTING RIBS

MALYUTIN, I. S., Moscow

[Abstract] A cylindrical sandwich shell with two different orthotropic load-bearing layers and an orthotropic light filler layer is studied. It is assumed that the deformation of the load-bearing layers follows

the hypothesis of straight perpendiculars, while the deformation of the filler, which is incompressible in the transverse direction and works only in shear, follows the hypothesis of straight lines. Interaction between the shell and ribs is schematically represented by a linear interface with the introduction of running contact forces, adjusted to the middle surfaces of the load-bearing layers. Figure 1; references 4 (Russian).

[317-6508]

PAL'CHEVSKIY, A. S., POLYAKOV, P. S., LARIONOV, I. F. and DEMERTSEVA, M. F., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] A study is made of a thinwall shell, consisting of two beveled cones. The cones are interconnected so that the top of the shell forms a complete circle. Evenly placed stringers are attached to the outside of the structure along the generatrices of the shell. The shell is loaded with a vertical force applied to the circular top and two horizontal forces, applied to the sides. The base of the shell is bolted to the test stand. The deformations of the shell are measured by resistance strain gauges. The critical load of the system is determined by a method developed for ribbed cylindrical shells, which considers the combined effect of axial compression and twisting. The calculations show that the lowest critical load corresponds to outward bulging of the top section. Figures 4; references 3 (Russian).

[317-6508]

A STUDY OF FLEXIBLE ELASTIC-PLASTIC SHELLS WHICH ARE RECTANGULAR IN PLAN
USING THE THEORY OF FLOW AND DEFORMATION THEORY

KRYS'KO, V. A., Saratov Polytechnical Institute

[Abstract] Initial differential equations of the theory of flexible
elastic-plastic shells are derived for rectangular elastic-plastic
shells under the following assumptions: the body of the shell is
isotropic; the relative change in volume is small and results from
elastic deformation proportional to the mean pressure; the full increment
of deformation consists of the increments of elastic and plastic defor-
mations; the Prandtl-Reuss ratio is correct for the increments of plastic
deformation; the parameter $d\lambda$ is determined from the conditions of
isotropic hardening by the flow theory associated with the Mises flow
conditions; the increments in components of elastic deformation are
related to the increments in components of stress by Hooke law; the
Mises plasticity criterion and Kirchhoff-Love hypothesis are applicable.
Figures 3; references 3 (Russian).
$[3 \text{(-,50)}]$

EXPERIMENTAL STUDY OF THE INFLUENCE OF RIBS ON THE NATURAL OSCILLATING
FREQUENCIES OF TRUNCATED CONICAL SHELLS

SIVAK, YE. F., Institute of Mechanics, Ukrainian Academy of Sciences,
Kiev

[Abstract] An experimental study of the natural frequencies and modes
of oscillations was performed on a test stand consisting of a massive
base, to which two brackets with conical disks 10 mm thick were rigidly
attached, to hold the shell being studied between them. The shells were
made of rolled AMG-6m alloy 0.5 mm thick, the ribs were made of angle
sections. An unsupported cylindrical shell and two series of supported
and unsupported truncated conical shells were tested. The natural
frequencies and modes of oscillations of the shells were determined by
a resonance method. The experimental data indicated that the minimum

natural frequency of an unsupported, slightly conical shell is practically
the same as that of a cylindrical shell with a radius equal to the average
radius of the truncated cone. As the frequency increases, the difference
in natural frequencies between conical and equivalent cylindrical shells
increases. The experimental values of the highest frequencies were
significantly lower than the theoretical values. Figures 4; references
5 (Russian).

[317-4508]

DESIGN OF A TRUNCATED SPHERE FOR WIND LOAD

YEMEL'YANENKO, V. V., Institute of Mechanics, Ukrainian Academy of
Sciences, Kiev

[Abstract] Results of wind-load studied for truncated spheres, using
the general theory of thin shells, are presented. It is shown that
when the contour of a spherical shell is rigidly clamped, the zero-moment
state is not realized. The equation system derived is also solved for
other boundary conditions: articulation and partial limiting of the
contour. The moments for these types of attachment are found to be
3 to 4 times less than the forces. Figures 3; references 8 (Russian).

[317-4508]

LOAD-BEARING CAPACITY OF PLATES AND SPHERICAL SHELLS WITH RIGID INCLUSIONS
UNDER ANTISYMMETRICAL LOADING

KOGORUKOV, S. N., Chelyabinsk

[Abstract] A study is made of the limiting equilibrium of circular
plates and spherical shells loaded through a rigid inclusion with bending
moments under various conditions of support and connection to the in-
clusion. The material of the plate or shell is assumed to be rigid-

plastic. The conditions of attachment of the structure to the support
and to the inclusion may be articulated or rigid. Figures 6; references
6 (Russian).
[317-6507]

STUDY OF UNSTEADY RANDOM OSCILLATIONS OF MULTIPLE-MASS SYSTEMS

REZNIKOV, L. M., Dnepropetrovsk Division, Institute of Mechanics,
Ukrainian Academy of Sciences

[Abstract] Unsteady random oscillations of multiple-mass systems which
have received kinematic perturbations are studied by the method of
moments. The method is applicable to the design of structures for
wind, earthquake and explosive loads, and involves the analysis of a
system of Cauchy linear differential equations with variable coefficients.
Several calculation examples are presented, including a study of the
vibrations of a platform moving at variable speed over a track with
random irregularities. Figures 5; references 5 (Russian).
[317-6507]

STABILITY OF LONGITUDINAL PERTURBED MOTION OF AIRCRAFT WITH LIFT CONTROL
SYSTEMS

PENTYUKHOV, V. I.

[Abstract] The addition of wing-mounted lift control surfaces improves
the performance of aircraft in the presence of air turbulence. In this
connection, the effect of aerodynamic characteristics of such extra
control surfaces on the dynamic stability of aircraft is investigated
by deriving the equations of longitudinal perturbed motion of aircraft
with such a lift control system when flying in a turbulent atmosphere,
proceeding from the classical equations of flight dynamics and using
the root hodograph method. The polynomial whose roots represent the
initial points of the trajectory of the roots of the characteristic
equation of longitudinal perturbed motion of aircraft with a lift control
system is derived. It is concluded that channel coupling assures a more
effective performance of lift control systems in various types of air-
craft, including those with sweptback wings. Figure 1; references 4
(Russian).
[291-13??]

DRIFT COMPENSATION IN AN OPTICAL GYRO COMPASS

KUZNETSOV, G. N., SERGEYEV, M. A. and LYMBKE, V. V., Chair of On-Board
Control Instruments, Leningrad Institute of Precision Mechanics and
Optics

[Abstract] An optical gyrometer in a gyro compass is considered whose
sensitivity axis periodically rolls through a 180° angle, driven by a
programmed servomechanism, about an axis in the plane of the horizon
while the azimuth is measured and the readings processed by a digital
computer. The leveling error is estimated, and it is shown how the
effect of drift of the optical gyrometer on the compass readings can
be almost completely eliminated. Figures 2; references 3 (Russian).
[301-413?]

OPTIMALLY FAST HOMING OF A CORRECTED GYRO COMPASS INTO THE MERIDIAN
PLANE

FAVORSKIY, K. G. and BOROZDIN, V. N., Moscow Institute of Aviation imeni
S. Ordzonikidze

[Abstract] Optimally and quasi-optimally fast homing of a gyro compass
into the meridian plane is analyzed. The homing conditions are determined
from the equations of precession for the sensitive element of a compass
with correction on a stationary base and by applying Pontryagin's maximum
principle to a nonlinear control object. The phase trajectories are
calculated, with known constraints on the control torques. Stabilization
in the "gyro azimuth" mode and in the "gyro compassing" mode is considered,
with the damper turned off and the indicator freely suspended. The
appropriate switching lines are found in the phase plane and the appropriate
homing conditions can be realized either manually or automatically.
Figure 1; references 7: 5 Russian, 2 Western.
[9-1-41]

ANALYSIS OF THE INSTRUMENTAL ERROR IN MEASUREMENT OF ANGULAR INFORMATION
FROM ELECTROSTATIC GYROSCOPES

TIMOFEYEV, V. V., Moscow Higher Technical Academy imeni N. E. Bauman

[Abstract] An attempt is made to analyze the instrumental error arising
during static testing of an instrument, in order to determine the in-
dividual components of the total error. A flow chart is presented for
the computer program used for modeling, which confirmed the correctness
of the equations developed in the article: with errors of orientation of
the chamber relative to the vertical axis of 0.5°, azimuthal error on
the order of 2° and cone error 1°, instrumental error is not over 5
angular minutes. Figures 3; references 3 (Russian).
[3-9007]

MODIFICATION OF KINEMATIC EQUATIONS FOR THE VECTOR PARAMETERS OF ORIEN-
TATION FOR A PLATFORMLESS INERTIAL NAVIGATION SYSTEM

VLASOVA, L. S., Moscow Aviation Institute imeni S. Ordzhonikidze

[Abstract] Determination of the matrix of direction cosines between the
axes of a trihedron coupled with an object and the base axes is one of
the key problems of inertial navigation. Earlier works have studied
algorithms for determination of the matrix through intermediate rotation
parameters such as the orientation vector and finite rotation vector.
This work introduces a vector $\overline{S}$ in the direction of the axis of rotation
and equal in magnitude to the sine of half of the angle of rotation.
This angular position vector greatly simplifies the computation of the
orientation parameters in comparison to the orientation vector and
finite rotation vector, allowing the on-board computer system of a
spacecraft to solve the problem of inertial navigation with greater
accuracy. References 4 (Russian).
[3-050]

ESTIMATION OF THE REQUIREMENTS FOR ON-BOARD COMPUTER SYSTEMS FOR INERTIAL
STABILIZATION SYSTEMS

BYKOVA, G. M., Leningrad Institute of Aviation Instrument Building

[Abstract] Earlier works on analysis of the accuracy characteristics
of algorithms defining the angular orientation of an object have not
analyzed the equations relating the accuracy of the computation algorithm,
the characteristics of the motion of the object and the parameters of
the on-board computer system. In this work, the problem is solved by
the method of digital modeling for algorithms using the Rodrigues-Hamilton
parameters and direction cosines. Algorithms are studied which consider
first, second and third order terms, assuming that the object being
controlled must operate for a long time independently. A Razdan-3
computer was used to model the process. A nomogram is presented for a
first-order algorithm using direction cosines. Figures 2; references
5: 4 Russian, 1 Western.
[3-090]

MOTION OF GYROSCOPE DURING ACTUATION OF ROTOR BY FLEXIBLE COUPLING

RASPOPOV, V. YA., Tula Polytechnic Institute

[Abstract] In gyroscopic instruments the rotor is started by means of a flexible coupling (belt, rope). During acceleration of the rotor such instruments are subject to vibrational motions due to the presence of the flexible coupling between the rotor and the housing. Knowledge of the nature of these motions at the moment the acceleration ends is important, since these motions represent perturbations of the subsequent motion of the gyroscope. In this connection, a system of equations of the amplitude and frequency of torsional vibrations is derived to compute the parameters of motion of the gyroscope at the moment the acceleration is ended; these formulas represent the input formulas for the integration of the equations of motion of the gyroscope following the acceleration. Figures 2; references 5: 2 Russian, 3 Western.

[34-1397]

SELECTION OF THE PARAMETERS OF AN ACTIVE-TYPE MAGNETIC SUSPENSION

DEMYANENKO, T. V., FEDOROV, V. P. and YUSIM, G. V., Ryazan' Radio Engineering Institute

[Abstract] Compared with their passive counterparts, active magnetic centering systems display advantages such as greater rigidity of suspension and broader potential for reducing the perturbing moments with respect to the gyroscope axis being centered as well as for introducing electrical damping. The operation of such an active magnetic centering system is investigated by deriving the formulas for the electromagnetic forces exerted by the stator on the armature of the centering unit. The presented formulas show a number of shortcomings of the magnetic suspension, such as the presence of a tangential component of the electromagnetic force, cross couplings, and a rigidity imbalance, due to arbitrary variations in the controlling magnetomotive forces. A linear pattern of variation in the controlling magnetomotive forces assures a balanced rigidity of radial

centering and a zero tangential component of the electromagnetic force. The parameters of the suspension and the range of permissible displacements of the sensitive element of the gyroscopic instrument at which the effect of the above negative features of centering becomes insignificant can be selected from the given formulas. Figures 3; references 2 (Russian).

[314-13b6]

CALCULATION OF THE MAGNETIC SUSPENSION OF A SUPERCONDUCTING SPHERE BY THE METHOD OF SECONDARY SOURCES

KOSTIN, A. V., Scientific Research Institute of Applied Mathematics and Cybernetics, Gor'kiy State University imeni N. I. Lobachevskiy

[Abstract] Magnetic suspensions of superconducting spheres are used to develop primary data sensors for inertial navigation systems as well as for gravimenters. The method of secondary sources (O. V. Tozoni, "Raschet elektromagnitnykh poley na vychislitel'nykh mashinakh" [Computer Calculation of Electromagnetic Fields], Kiev, Tekhnika, 1967, p 56; O. V. Tozoni, "Metod vtorichnykh istochnikov v eletrotekhnike" [Method of Secondary Sources in Electrical Engineering], Moscow, Energiya, 1975, p 182) is an effective method for calculating the magnetic fields of magnetically piecewise-continuous bodies: for such bodies this method reduces to finding the secondary sources (surface currents or magnetic charges) at the boundaries of the magnetics by means of a computerized numerical solution of Fredholm integral equations of the second kind. This method is now used to calculate the axial rigidity and field distribution at the surface of the superconducting sphere for an axisymmetric suspension in the presence of fixed currents in the magnetization coils. The validity of this method is demonstrated, as is its applicability to other suspensions in the class considered. For an axisymmetric suspension it is expedient to select as the secondary sources the density of the surface currents at the sphere, since it has only one--azimuthal--component in a cylindrical coordinate system. Figures 3; references 10 (Russian).

[314-13b6]

PROGRAMMED CONTROL OF THE ANGULAR MOVEMENT OF A GYROSTAT IN A CENTRAL
FIELD OF FORCES

ZAKRZHEVSKIY, A. YE., Institute of Mechanics, Ukrainian Academy of
Sciences, Kiev

[Abstract] A study is made of a solid body moving in a central field of
forces in a circular orbit. The body contains transducers which sense
the angular coordinates and angular velocities, a computational unit for
the formation of control moments and actuating elements for control
purposes. The actuating elements are three single-stage gyroscopes, the
axes of rotation of which are oriented along the primary axes of inertia
of the entire system. The equations of motion of the object consist of
three dynamic Euler equations, and the dynamics of the objects are
described using these plus kinematic equations and the equations of rotary
motions for flywheel engines. The task of constructing the equations to
be used by the computational unit to generate the control moments so as
to assure stable programmed movement of the object is studied. Figures 3;
references 5 (Russian).

[115-59]

DESIGN OF AN IMPACT-TYPE VIBRATION ABSORBER FOR A GYRO

PRIVALOV, YE. A., Institute of Problems in Mechanics, USSR Academy of
Sciences, Moscow

[Abstract] Suppression of gyro vibrations by an impact-type absorber is
analyzed, such an absorber in the form of a ring being slipped with
clearance on a bar which extends from the gyro case and the gyro being
mounted in a Cardan suspension. The system of second-order differential
equations describing the angular motion of such a gyro with the absorber
is, assuming negligible absorber weight and friction, reduced to first-
order differential equations which then yield a second-order differential
equation describing the linear motion of the absorber. The steady state
vibrations of this mechanical system are calculated, and the stability

range is established from the amplitude-frequency characteristics. The effectiveness of such an absorber is demonstrated by a comparison of exact gyro trajectories, without and with absorber respectively, in the coordinate plane of the two rotation angles about the inner axis and the outer axis respectively. The author thanks D. M. KLIMOV for the assistance. Figures 4; references 2 (Russian).

/31i-2415/

USSR

POSSIBLE PARAMETERS OF ELECTRICAL POWER TRANSMISSION EARLY IN THE NEXT CENTURY

POPKOV, V. I., Moscow

[Abstract] Trends in this century are used to extrapolate power transmission early in the next century. High-voltage AC transmission lines are considered as an example, their capacity having risen from roughly 100 kV early in this century to nearly 1000 kV at present. This steady rise in transmission line voltage may be regarded as a function of the nation's total electric power output. A corresponding analytic formula is presented for line voltage as a function of the square root of power output and on the basis of computer calculations is used to extrapolate power output and transmission line voltages in the USSR and the United States until the year 2020. The extrapolation assumes a 5.5% annual rate of increase in power output for the USSR and 3.7-5.8% rate for the United States. One conclusion is certain: so long as electricity generation continues to increase, individual line voltages will also increase--to about 2000 kV by the end of this century and 3000 kV in the year 2020. In the 1980s, in the USSR at least, 1200 kV lines will be introduced, and it is time to commence R&D work on 1800-2000 kV lines and schedule them for introduction in the 1990s, since, as experience shows, it takes 10 years between the conception of the idea and the development of power transmission lines with higher voltage. In view of the problems inherent in traditional power transmission lines, research should be undertaken into other types of power transmission such as gas-insulated, cryoresistant, superconducting, and others.
[513-1357]

USSR   UDC 621.3.013.1:621.313.322-81.001

CALCULATION OF THE MAGNETIC FIELD OF A TURBOGENERATOR WITH A RELATIVELY NONMAGNETIC ROTOR

GRINBAUM, I. N., Leningrad

[Abstract] To elucidate the question of the rational extent of saturation of the stator core of a turbogenerator, the magnetic field of the turbogenerator is calculated with allowance for the nonlinearity of the

magnetization curve of transformer steels. It is shown that the permeability of the ferromagnetic core can be approximated by the product of two analytic functions, each dependent on the corresponding coordinate. The proposed computational method assures a practically sufficient accuracy of calculation of the losses in the ferromagnetic core and in the armature winding. This method takes only one-fourth as much computer time as do the numerical methods. In this connection, a formula for the increase in loss due to eddy currents in the stator core as a function of alternating magnetization and the presence of higher harmonic induction is derived. Figures 4; references 7 (Russian).

/315-13767

A PROCEDURE FOR CALCULATING THE PARAMETERS OF DAMPING NETWORKS IN HIGH VOLTAGE SEMICONDUCTOR CONVERTERS

GLAZENKO, T. A. and BUDILOV, B. A., Leningrad Institute of Precision Mechanics and Optics

[Abstract] Series strings of thyristors are used in various high voltage conversion devices, and because of the scatter in their parameters, the loads across them are usually equalized by inverse voltage RC network dividers. A model is proposed for thyristors shunted by a series RC network which treats the thyristors as current sources during the cutoff process, where the model takes into account the lifetime of holes in wide n-bases of the thyristors and is used in the analysis of the distribution of the inverse voltage across the series connected thyristors. Analytical expressions are derived for the design parameters of the shunting networks and applied to the case where five type T150 thyristors are connected in series. The voltage across the thyristor with the fastest response is shown graphically as a function of time for the following parameters: forward current of 28 A, back current of 14 A and permissible inverse voltage of 600 volts. The hole lifetime in the n-bases was measured and ranged from 8.8 to 17.98 microseconds for the five thyristors. A value of 0.17 microfarads was found for the capacitor and 16 ohms or less for the resistor of the shunting network. The proposed approach leads to a more precise determination of the RC parameters, a reduction in the calculated capacitance in the absence of reverse overvoltages across the thyristor string, and thus to improved operating conditions for the thyristors in the switching intervals. Figures 2; references 3 (Russian).

/90-1857

CERTAIN PROBLEMS OF THE DEVELOPMENT AND OPERATION OF STEAM TURBINES

TROYANOVSKIY, B. M. and TRUKHNIY, A. D., Moscow Power Engineering Institute

[Abstract] Steam power stations accounted for 86% of all electricity
generated in the USSR in 1978, hence special attention must be paid to
R&D work on high-capacity steam turbines. In particular, an increasing
number of 200-, 300-, 500-, 800- and 1200-MW turbines will be built. In
addition, there is the LMZ-1200-240 turbine whose 1380-MW capacity makes
it the world's largest, and whose titanium-alloy blades make it an ad-
vanced design. These blades have now withstood many tens of thousands
of hours of performance, and it is only recently that the American Westing-
house Company and other foreign companies began to be interested in them.
An important factor in increasing the operating efficiency of steam power
stations is raising the initial steam temperatures. Many Soviet turbines
operate at initial steam parameters of 565°C and the LMZ K-150-170 turbine
even operates at 580°C, while the K-100-300-31 unit has so far worked
for 15,000 hr at t_0 = 630°C. But widespread conversion to such high
parameters is still a matter of the future. As for the turbines used in
atomic power stations (APS), their parameters vary depending on the reactor
type--most often the water-cooled water-moderated reactor. Foreign APS
nearly always use single reactor-single turbine units, whereas Soviet
APS use single reactor-twin turbine units, thus assuring higher operating
reliability. Other differences are: Soviet-built saturated-steam turbines
are designed for a deeper vacuum than their foreign counterparts. Further,
the USSR alone builds high-speed saturated-steam turbines with four low
pressure cylinders. Other turbine types on which R&D work continues include
the turbines used in heat and power stations; the broadening of the
operating range and diversification of the types and sizes of these
combines is of special interest in view of the economic advantages of the
combined generation of heat and electricity. The general consensus is
that the minimum capacity of the saturated-steam turbines used in atomic
heat and power stations with water-cooled reactors should be more than
400-500 MW. There also exists the category of off-peak turbines, which
necessarily must be a simplified and cheaper design to save fuel. The
LMZ Leningrad Metal Plant has designed and built the K-500-130 off-peak
turbine designed to operate under a load varying from 50 to 100%. The
problem of operating-range flexibility is becoming acute in connection
with the sharp increase in the share of APS and the retirement of old
and worn 160- and 210-MW boiler-turbine units. Figures 9; references
43: 24 Russian, 19 Western.

[01-13-02]

PHOTOELECTROCHEMISTRY AND SOLAR ENERGY CONVERSION

PLESKOV, YU. V.

[Abstract] In view of the low solar radiation per unit surface area of the earth and the marked diurnal and annual fluctuations in the extent of that radiation, the problem of solar energy retention attracts increasing interest. Hence techniques for converting solar energy to the chemical energy of the products of photochemical (and in particular, photoelectrochemical) reaction rather than to electrical current, are of principal interest. In this review the photoelectrochemical devices for solar energy conversion are divided into two groups depending on the locus of light absorption (and hence also depending on the locus of the primary photoprocess): in the solution--photogalvanic cells, or on the electrode--photovoltaic cells. A classical example of photogalvanic cells is the thionine--iron ion systems. Analysis of the theory of photogalvanic systems shows that their maximum efficiency can hardly exceed 1% and hence their future potential is limited. Photovoltaic cells, in which semiconductors are used as the light-absorbing electrodes, can reach a maximum efficiency of 8% as of the present. The potential of the photoelectrochemical method for large-scale power generation remains as yet a question mark. It appears that the most promise is displayed by photocells of the regenerative type, but the problem of their stability has yet to be solved without detriment to their principal advantage--the possibility of using polycrystalline (and therefore low-cost) materials. As for the photoelectrolysis of water, the results so far provide no grounds for optimism. Currently the most promising is the two-stage method of producing hydrogen by electrolysis of water in a conventional electrolyzer powered electrically by solar batteries. Figures 2.

[8117-13167]

MeV NEUTRON SPECTRA IN FAST CRITICAL ASSEMBLIES

LITYAYEV, V. M., DULIN, V. A. and KAZANSKIY, YU. A.

[Abstract] Neutron spectra are a highly important characteristic, since
the quantitative side of any process occurring in a reactor is represented
by averaging the interaction cross sections of neutrons over their
spectrum. A scintillation spectrometer with discrimination of gamma-
radiation over glow time and with a stilbene crystal was used in measure-
ments of the neutron spectrum at the center of three critical assemblies,
using a miniature isotropic ^{252}Cf source as the standard neutron source
within the 0.4-10 MeV energy range. Of the three critical assemblies
used, the BFS-30 assembly has a composition close to that of the high-
enrichment zone of a fast reactor with an oxide fuel and a sodium heat
transfer agent, while the BFS-33 and BFS-35-1 assemblies are represented
by media consisting of uranium oxide and uranium metal with an enrichment
assuring $K \simeq 1$. The measured group neutron fluxes were found to be in
agreement with their theoretically computed counterparts. The variation
of the mean ^{238}U fission cross section amounts to -1.2, -1.1 and -2%,
respectively for the assemblies BFS-30, -33, and -35-1, when the measured
neutron spectrum is used for averaging instead of the 1/E spectrum. Figures
2; references 9: 7 Russian, 2 Western.
[9.-13.]

UNSTEADY DIFFUSION OF PROMPT NEUTRONS IN FAST FUEL ASSEMBLIES

KOLESOV, V. Ye., MAKAROV, O. I. and MATVEYENKO, I. P.

[Abstract] The numerical determination of unsteady-state processes is
important for evaluating the limits of the range of existence of asymptotic
(or quasi-asymptotic) neutron flux distributions in experiments with a
pulsed source of prompt neutrons. The corresponding many-group unsteady-
state diffusion equation is considered. The equation is solved by the
difference method. A numerical solution of the many-group problem with a
number of groups exceeding 20 is derived on tracing the dynamics of the

variation in the neutron flux from the initial pulse until the steady-state value, on condition of asymptotic stability. The resulting solution was programmed in ALGOL for an M-220 computer. The agreement between experiment and theory demonstrates the applicability of the approximation equations for the calculations of the kinetics of prompt neutrons in fuel assemblies (up to $K_{eff} = 0.7$). Figures 2; references 4 (Russian).
[294-13??]

LEBED', B. M. and MARCHIK, I. I.

[Abstract] A major problem of experimental nuclear physics is achieving a high coordinate resolution in the recording of fission fragments, protons, neutrons, etc. In this connection, the physical considerations governing the feasibility of the development of crystalline coordinate detectors and the pertinent experimental findings are presented. The discussion is limited to ferromagnetics, but it applies equally to ferroelectrics. Phase transitions of the first kind in ordered media, stimulated by nuclear radiation, are examined. Results of experimental studies of the inter- action between multiplycharged particles and the magnetic structures in ferrites are presented. It is shown that in single crystal ferrite films charged particles cause a local variation in magnetic structure in the region of interaction with the material--the formation of a unitary domain. This effect can be utilized to design particle detectors with a high coordinate resolution, as indicated by the experimentally achieved resolution of $15 \cdot 10^{-6}$ for fission fragments. The use of ferrites and semiconductors as counters can simplify experimental equipment for research in nuclear physics and open up new possibilities for organizing experiments, e. g. in magnetic neutron diffraction. Figures 3; references 5: 4 Russian, 1 Western.
[3?3-13?6]

VACUUM FISSION CHAMBERS FOR NEUTRON DETECTION

DMITRIYEV, A. B., MALYSHEV, YE. K. and SHCHETININ, O. I.

[Abstract] There is a need for neutron detectors with a higher sensitivity corresponding to the energy dependence of the fission cross section of nuclear fuel. In this connection, vacuum fission chambers, based on the utilization of electron emission under the action of fission fragments, are of interest. Two design types of such chambers are discussed: with cylindrical and with plane-parallel electrode systems. The simpler of these two is the cylindrical system, consisting of two coaxial cylinders. But the chamber with a plane-parallel electrode system assures a virtually total utilization of detector space, which serves to enhance detector sensitivity. The design of one such chamber, the KNV-1, is described. The virtually inertialess nature of vacuum fission chambers makes them useful for monitoring not only steady-state but also pulsed fluxes of neutron and gamma radiation. Figures 3; references 6: 4 Russian, 2 Western.

[3-1467]

RADIAL MOVEMENT OF THE PLASMA COLUMN IN A TOKAMAK FUSION REACTOR

MANUYLOV, V. S.

[Abstract] A major problem of tokamak design at present is insulating the plasma column from the walls of the discharge chamber. Advances in this field hinge on the analysis of the dynamic properties of discrete components of the tokamak thermonuclear reactor, including the plasma column (PC) itself. In this connection, a mathematical model of the radial movement of the PC is developed with allowance for its ohmic resistance as well as for total flux linkage of the circuit formed by the PC. The effect of metal structures of the reactor on the radial movement of the PC was not taken into account. A major limitation on the applicability of the presented model is the requirement of small curvature of the PC. Under these conditions it is shown that the movement of the PC from one equilibrium position to another with variation in the magnetic field is

of a complex nature. The parameters of the elements of that movement
markedly depend on the input characteristics of the PC. To present-day
tokamaks with their high-curvature PC these findings can apply only
qualitatively. But in the event of the experimental corroboration of the
derived properties, the presented mathematical model will be useful in
designing PC parameter stabilization systems in present-day tokamaks as
well. Figures 5; references 4: 1 Russian, 3 Western.

[3-3-13ʰᵘ]

SYSTEMS FOR MAGNETIZING FERRITES IN TUNABLE ACCELERATING RESONATORS FOR
PROTON SYNCHROTRONS

AVERBUKH, I. I., Institute of Nuclear Physics, Siberian Department,
Academy of Sciences USSR, Novosibirsk

[Abstract] A examination is made of different ferrite magnetizing
systems, and systems are analyzed from the standpoint of getting a
wider tuning t ge and more rf power with a minimum volume of ferrite
in tunable resonators. Various magnetizing, decoupling and cooling
systems are considered with regard to their influence on the oscillatory
power per unit of ferrite volume and on the ratio of the maximum frequency
of the resonator to the initial frequency. It is found that the rf power
and tuning range are maximized with minimum ferrite volume in a system
with tuning in an electromagnet. Figures 7; references 8: 6 Russian,
2 Western.

[1-.10]

ON THE FEASIBILITY OF TELEVISION REGISTRATION OF PARTICLE TRACKS IN A
STREAMER CHAMBER

VOLKOV, V. V., GRECHNEV, V. V., KANTSEROV, V. A. and SOMOV, S. V.

[Abstract] An examination is made of the limitations imposed on systems
for television display of particle tracks in a streamer chamber. These
limitations are due to time, brightness and resolution problems. A
technique is proposed for experimental evaluation of the brightness of
particle tracks in a streamer chamber, and measurement results are given.
Relative sensitivities are measured for methods of recording the infor-
mation generated in a streamer chamber: direct photography on type 29
film, photography on RF-3 film through a UM-93 optical image converter,
registration without film on the LI-421 vidicon with preamplification by
the UM-93 converter, and filmless registration with the LI-214 super-
orthicon. It is found that the sensitivity of the LI-214 is close to
that of type 29 film, and is adequate for setting up filmless registration
of data from streamer chambers. A system with an image converter and a
vidicon gives the most reliable filmless registration of streamers in
the chamber. Figures 2; references 3: 2 Russian, 1 Western.

[779-9407]

AN ION-DOPED SEMICONDUCTOR NEUTRON COUNTER WITH HIGH REGISTRATION
EFFICIENCY

GVERDTSITELI, I. G., GULDAMASHVILI, A. I., ZHIRNOV, V. D., AGRBA, T. M.
and SHAUMYAN, T. A.

[Abstract] A semiconductor counter with p-n junction is described for
highly efficient registration of thermal neutrons. The ion doping tech-
nique was used for saturating the crystal with dopant. The dopant
concentration in the crystal is considerably greater than the limiting
equilibrium concentration. Neutron registration depends on detection of
reaction products on nuclei of the absorber (^{10}B) with neutron capture.
The inversion layer is combined with the absorber and is formed by ion

doping. A counter .th a working area of 0.3 cm^2 has high efficiency of thermal neutron registration and high energy resolution. The authors thank E. L. Andronikashvili for providing the opportunity of studying the detector on the reactor at the Institute of Physics of the Georgian Academy of Sciences, G. S. Karumidze for cooperation with the work, and N. M. Katamadze and A. V. Mandzhavidze for assisting in the work on the reactor. Figure 1; references 12: 6 Russian, 1 Polish, 5 Western.
[275-6610]

IVANOV, V. A., BOROVKOV, V. M., IGNATENKO, YE. I., YEPERIN, A. P., UMANETS, M. P., KULIKOVA, G. G. and SLESARENKO, V. V., Leningrad Polytechnic Institute, Kola Atomic Power Station, Leningrad Atomic Power Station

[Abstract] Conversion to variable pressure in the wet-steam turbines of atomic power stations (APS) entails extensive changes in the performance characteristics of APS equipment. The various aspects of the introduction of variable turbine pressure are now evaluated for water-cooled water-moderated and channel-type reactors. For water-cooled water-moderated reactors variable steam pressure in the turbine improves operating-range flexibility, provided that allowance is made for the marked changes in the temperatures of the heat transfer agent with decrease in steam pressure. In channel-type reactors the conversion to variable pressure has more far-reaching consequences: the decrease in the pressure and temperature of the heat transfer agent directly in the reactor channels reduces the temperature of the fuel and the graphite moderator but increases volumetric steam content. The decrease in the temperature of the moderator reduces the reactivity margin, while the increase in volumetric steam content increases that margin. Calculations and experiments show that the increase in volumetric steam content more than offsets the decrease in reactivity margin due to the decrease in temperature of the moderator. The introduction of variable steam pressure holds considerable latent potential for increasing the efficiency of APS and there is a need for coordinating the research efforts in this direction. Figures 4; references 10 (Russian).
[291-13-6]

GAS-CYLINDER CARS AND BUSES AS A MEANS OF REDUCING ATMOSPHERIC POLLUTION
AND INCREASING THE COST EFFECTIVENESS OF TRANSPORT

SATAROV, V. A., deceased, GOL'DBLAT, N. I. and KOLUBAYEV, B. D.

[Abstract] To improve public health it has been decided to further con-
vert part of vehicular transport in Moscow and other large cities to
liquified gas. In this connection the NAMI Scientific Research Institute
of Motor Vehicle Transport has, in collaboration with automotive plants,
developed and tested the pertinent equipment. The positive results of
these tests resulted in the commencement of the production of motor
vehicles equipped with gas cylinders and gas-burning engines with in-
creased compression ratios optimal for liquified propane-butane gas, such
as the GAZ-59-09 (taxi), the ZIL-MMZ-45023 dump truck, the GAZ-52-08 van,
the LiAZ-677G and LAZ-695P buses, the GAZ-24-07 passenger car-taxi, and
others. Tests of the ZIL carburetor and gas engines showed that for them
the carbon monoxide content of the engine exhaust gases is one-fourth as
low as that of a gasoline-burning engine. The gas cylinder package for
motor vehicles operating on liquified gas is represented by a set of
special equipment and connecting lines. The principal components of that
package are a cylinder containing the necessary supply of liquified gas
under a pressure of 16 kg/cm^2, a hand- or power-operated valve for rapid
disconnection of the gas line from the driver's seat, a vaporizing device
for converting the liquified gas from liquid to gaseous state, and a
fuel feeder device reducing the gas pressure, proportioning the supply
of gas and mixing it with air. The operating principle of this package
is the same regardless of the automobile make on which it is installed;
it differs only in the number and size of gas cylinders and gas-reducing
and -mixing devices. Analysis of individual elements of the maintenance
cost of the buses LiAZ-677 and LAZ-695N and the truck ZIL-138 shows that
their conversion from operation on gasoline to that on liquified gas
assures a marked reduction in fuel expenditures as well as a general
reduction in their operating cost. Figures 7; references 5 (Russian).
[4-12]

USSR

HIGH-TEMPERATURE CHARACTERISTICS OF DIFFUSED PLANAR TRANSISTORS OPERATING
IN THE INVERSION MODE AND TRANSDUCERS BUILT WITH SUCH TRANSISTORS

GADZHIYEV, N. D.

[Abstract] A theoretical analysis of a diffused planar silicon transistor,
on the basis of its current voltage characteristics and the temperature
dependence of its high-conduction voltage in the inversion mode, indicates
that such a transistor can be used for temperature measuring devices at
temperatures as high as 380-400°C. The temperature of intrinsic con-
ductivity calculated by extrapolation of the voltage-temperature curve
has been found to be higher than according to the characteristics of the
collector junction and the emitter junction, with the "emitter" area much
larger than the "collector" area in the inversion mode, because of
different doping levels in the collector region and in the base region.
The temperature dependence of the voltage drop from turn-on to turn-off
and the temperature dependence of the signal frequency have been determined
for an integral temperature transducer using such a transistor, the
voltage drop decreasing only slightly and the frequency increasing fairly
linearly up to 240-250°C. Figures 5; references 6 (Russian).
[854-2415]

USSR   UDC 62-501.72

A METHOD OF IDENTIFYING A TRANSIENT PULSE RESPONSE

ANISIMOV, A. S. and YEVGRAFOVA, L. A., Chair of Automation and Telemechanics,
Novosibirsk Institute of Electrical Engineering

[Abstract] A method is proposed for identifying the transient pulse
response of a linear stationary object describable by a convolution
integral. The identification is based on realizations of the input
signal and the output signal, both having been measured with errors.
The method involves a Taylor series expansion and a Cauchy problem for
the corresponding differential equation. A solution by successive
approximations is possible, exponential stability provided, in the case

of incomplete or imprecise information. The identification can be aided by computer simulation, this method being more interference-free and accurate than identification methods based on approximation of the sought response with Fourier series. Figures 2; references 3 (Russian).
[301-4157]

HOLOGRAPHIC INSPECTION OF ASPHERICAL SURFACES

LARIONOV, N. P., LUKIN, A. V. and RAFIKOV, R. A.

[Abstract] A holographic method is considered for checking lenses and mirrors with convex surfaces and optical elements with great curvature when the surfaces to be checked are not spherical. The technique is based on the principle of double-exposure holographic interferometry, with a standard spherical surface placed at the location of the specimen for the first exposure, after which the object to be checked is then placed in the same position. The reconstructed hologram gives a very accurate check on the surface. Figures 4; references 10. 7 Russian, 3 Western.
[117-6930]

CALIBRATION CURVE FOR DIGITAL ANALYZERS OF HEAT FIELDS AND A METHOD OF DERIVING IT

KUZ'MICHEV, V. N.

[Abstract] A technique is proposed for compiling a calibration table for digital heat field analyzers and deriving an approximating function for plotting a curve from the tabulated data. The calibration table gives the output voltages of the analyzer that correspond to each temperature in the working range as determined from reference measurements. An example of curve plotting shows that the calibration curve is best

approximated by a third-degree polynomial. However, a second-degree polynomial gives accuracy well within the margin required for quality control in turbogenerator assembly. Figures 2.

/ 7-6510/

HOLOGRAPHIC METHODS OF CHECKING ASPHERICAL SURFACES

LUKIN, A. V. and MUSTAFIN, K. S.

[Abstract] A brief survey of the literature on techniques and hardware based on holographic methods for checking optical surfaces of complex shape. Various applications of holographic interferometry and contour generation are considered. Basic parameters are summarized for synthesized holograms, and it is shown that the principles of holography can considerably expand the limits of practical application of shadow and interference methods of checking aspherical surfaces on all stages of production. Synthesized holograms eliminate the necessity for making master (reference) optical elements and compensation objectives, and provide interferometric accuracy in checking a wide range of aspherical surfaces of second and higher orders. Figures 10; references 60: 35 Russian, 25 Western.

/ 7-6510/

POLISHING FLINT GLASS

KUKLEVA, Z. A. and KOZHUKHOVA, V. T.

[Abstract] An examination is made of some of the physicochemical problems of polishing flint glasses that contain more than 45% lead oxides, up to 23% silica and more than 12% alkaline components. It is found that the use of sodium thiosulfite gives rise to dark patches of lead sulfide on the polished surface. A weakly basic medium (pH of 7.3-7.5) prevents the

formation of a lead hydroxide crust on the pitch lap by converting the lead to soluble plumbites or hydroxy salts. Flint glasses can be polished in an acid medium with pH = 5.5-6.5 in which the lead salts are in the soluble state. To stabilize the pH of the polishing medium for flint glass, it is recommended that buffer solutions based on alkali and a mixture of acetic, phosphoric and boric acids be used for the Polirit suspension with a pH of 6.2 for an acid medium, and 7.54 for a basic medium. References 4 (Russian).

[7-0610]

PRIMENKO, V. I. and PISARENKO, G. V.

[Abstract] An investigation is made of the influence that glass composition has on thermal diffusivity. Glasses were founded in the systems SiO_2-Me_2O, SiO_2-Me_2O-MeO, SiO_2-Me_2O-Me_2O_3, SiO_2-Me_2O-MeO-Me_2O_3, where the Me_2O are oxides of sodium and potassium, MeO are oxides of magnesium, calcium, barium, zinc and lead, and Me_2O_3 are oxides of aluminum and boron. The influence of titanium dioxide was studied on model systems of SiO_2-Na_2O-TiO_2 and SiO_2-Na_2O-CaO-TiO_2. Thermal diffusivity was calorimetrically determined. Under the experimental conditions, quasi-steady state heating began at about 100°C, and therefore the measurements were made above that temperature and extrapolated to the 0-100°C range. The upper limit of 600°C was dictated by the fact that above that temperature the influence of radiant conduction on heat exchange in glass becomes so great that temperature distribution is dependent on the cross section geometry. The results are tabulated for all oxides studied plus La_2O_3 and F_2 as determined from investigation of commercial grades of glass. The data are given by intervals of 50°C. References 7 (Russian).

[7-0610]

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AUTOMATIC MULTIPARAMETER INSPECTION SYSTEM FOR GAS TURBINE ENGINES

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[Abstract] Since no systematic procedure for selecting and optimizing the structure of automatic multiparameter inspection systems is available, a structure of such a system for inspecting gas turbine engines and their entire complex of performance characteristics has been developed on the basis of a preliminary analysis of five possible structures: decentralized ones without or with standby, centralized ones without or with standby, and a compound structure. The final structure chosen is a hybrid one, optimal in terms of technoeconomic indicators as well as metrological characteristics, which not only lacks the disadvantages of maximum installation cost of decentralized structures and maximum operating cost of centralized structures but even minimizes both costs to below those of a compound structure and includes only one digital control computer. Its introduction into a manufacturing plant for automatic inspection of gas turbine engines has greatly improved the productivity and the product quality. Testing time has been reduced by 40%, test stand capacity has been raised by 25%, and fuel consumption for engine tests has been reduced by up to 50%. Figures 6; tables 2; references 8 (Russian). [300-2415]

A MAGNETOMODULATION CURRENT METER FOR A CHARGED PARTICLE BEAM

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[Abstract] The paper describes a device for direct measurement of the constant component of beam current in the NAP-M proton accumulator. The sensor of the instrument is placed in the vacuum chamber of the accumulator and consists of two permalloy doughnuts with field windings and signal windings. An oscillator sends an alternating current at a frequency of 3000 Hz to the field winding, which produces permeability modulation that

in turn modulates the magnetic flux set up by the direct component of the beam current. As a result, two signals are induced in each of the signal windings: one proportional to the field current, and the other proportional to the current to be measured. The first signal is on the excitation frequency, and the second is double the excitation frequency. The second signal is amplified, detected and integrated. The integrator output sets up a compensation current in the signal windings that produces a magnetic field opposing the field of the beam current. This autocompensation principle expands the current measurement range and reduces errors. The measurement range is from 100 μA to 300 mA. Zero drift is no more than 15 μA in 8 hours, and 25 μA in two months. There is practically no zero drift from line instability or temperature variations in the laboratory. External fields up to 1600 A/m have no effect on operation of the instrument. The device can also be used for measuring direct currents in wires where contact measurements may be difficult. Figures 4; references 4 (Russian).

A DEVICE FOR CONTINUOUS MONITORING OF THE ENERGY SPECTRUM OF AN ELECTRON BEAM

VINOGRADOV, K. A.

[Abstract] Most applications of low-energy accelerators require continuous monitoring of the energy spectrum of the particle beam. In previous work, an achromatic beam transport system has been used for this purpose with spectral density measurement by a 10-channel secondary emission monitor. Since secondary emission is a surface effect, the lamellae of the converter in such a system can be made thin to minimize beam distortions. This paper describes a similar device for measuring broad energy spectra of particles in a relatively low-energy accelerator. An analyzing magnet and a rotating magnet form a system for parallel beam transport to the target. The spectral density converter is a secondary emission monitor with lamellae located in the focal plane of the analyzing magnet. A high-voltage electrode covers both sides of the lamellae with ports for passage of the particles. The beam spectrum is observed on an oscilloscope screen. The optical properties of the device are calculated. Measurement results are given. Figures 2; references 6: 2 Russian, 4 Western.

BACKGROUND OF GEIGER AND PROPORTIONAL COUNTERS CAUSED BY HARD COSMIC RAYS

KRUPA, R. J., Siedlce Pedagogical Institute, Poland

[Abstract] Experiments were done to determine the background relative to
a unit of active surface of Geiger and proportional counters caused only
by hard cosmic radiation. The experimental data used in the study are
taken from the author's dissertation (Military Technical Academy, Warsaw,
1973). The paper introduces the concept of the maximum specific background
$b = 1.22 \pm 0.34$ pulses/(min·cm^2) of the cross sectional surface of the
sensitive volume in the plane of the anode for typical Geiger and pro-
portional counters. The value given agrees well with analogous data
found by other authors for semiconductor detectors. Figures 2; references
15: 3 Russian, 7 Polish, 5 Western.
[75-6610]

NEW DATA ON DIELECTRIC HEAVY-ION BREAKDOWN COUNTERS BASED ON AN MOS
STRUCTURE

SMIRNOV, A. N.

[Abstract] A method recently developed for registration of fission frag-
ments is based on breakdown of a thin-film capacitor at the instant of
formation of a track by a strongly ionizing particle at a field strength
considerably lower than that required for spontaneous breakdown. In a
counter that utilizes this effect, the thickness of one of the metal
electrodes is selected so that it vaporizes rather than melting during
breakdown. This results in a larger hole in the electrode than in the
insulation, and short circuiting is avoided. In this paper an investigation
is made of the physical properties of such dielectric breakdown counters
for heavy ions based on an MOS structure of n-type silicon with sensitive
surface area of up to 110 mm^2. It is shown that the registration efficiency
is nearly 100%, and the energy threshold for heavy ions is 22 ± 2 MeV·cm^2/mg.
The maximum working resource in registration of fission fragments is about
$3 \cdot 10^6$ cm^{-2}. The author thanks A. S. Yakovlev for considerable assistance
in making the counters, and V. P. Eysmont for continued interest in the
work and constructive criticism in discussing the results. Figures 4;
references 2 (Western).
[75-6610]

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COMPARATIVE INVESTIGATION OF STRAIGHT-THROUGH AND STAGGERED LABYRINTH
PACKINGS

Moscow ENERGOMASHINOSTROYENIYE in Russian No 5, 79 pp 10-12

ORLIK, V. G. and SKOMOROVSKIY, A. Z., Khar'kov Turbine Plant and Central
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[Abstract] The results of an investigation of the flow of air in straight-
through and staggered labyrinth packings, performed with the aid of opti-
mizing their geometry in turbines with a considerable rotor elongation,
are presented. Of the straight-through packings, the most economical
proved to be the vernier type with projections on both sides; on the whole,
however, this type of packing is relatively unsuitable for the contemporary
high-power steam turbines, particularly those used in atomic power stations,
in which the axial displacements of the rotor reach 50 mm and more and
the radial clearances reach as much as 1-2 mm owing to the considerable
rotor dimensions, since under these conditions greater transfer of kinetic
energy takes place in such packings. Of the staggered packings investigated,
the packings with projections having a height and width of not more than
twice the radial clearance display the optimal geometry of air flow.
References 7: 5 Russian, 2 Western.

[298-1386]

USSR   UDC 62.135:531.351

CHARACTERISTICS OF AN INWARD-FLOW TURBINE WITH HINGED GUIDE BLADES

Moscow SUDOSTROYENIYE in Russian No 6, 79 pp 22-24

TIKHOPLAV, V. YU. and TIKHOPLAV, T. S.

[Abstract] The characteristics of a radial-axial inward-flow turbine
were investigated as a function of the angle of adjustment α_a of its
hinged guide blades, on a specially designed experimental test stand.
The variation of α_a within a broad range of from 6 to 174° made it
possible to develop an optimal program for adjusting turbine power so as
to assure the maximum possible operating efficiency in the presence of
partial loads. In this paper two optimal programs were derived. The
first produces the highest possible gain in relative efficiency (up to
21%) on reducing load to 40% below rated load, and is associated with
changing both the adjustment angle of the guide blades and the rotor rpm.
The second program was developed for turbines with a fixed rotor rpm and

it assures a gain of 14% in relative efficiency for the same range of load reductions compared with the efficiency of turbines having fixed guide blades. Analytic formulas for the characteristics of inward-flow turbines are derived on the basis of the Euler turbine equation, conditions of continuity, inlet and outlet triangle ratios, and the gas-dynamic formulas used in the theory of turbomachinery. The experimental findings are found to be in agreement with theory. References 8 (Russian).

[295-1386]

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USE OF SEGMENTED BEARINGS TO ENHANCE THE VIBRATION RESISTANCE OF TURBINE ROTORS

Moscow TEPLOENERGETIKA in Russian No 6, 1979 pp 64-67

KOSTYUK, A. G., KUMENKO, A. I. and SHOSHIN, V. G., Moscow Energy Institute

[Abstract] Segmented journal bearings are increasingly widely used in turbine building with the object of preventing the low-frequency vibration of large turbine units. In this connection, a K-300-240 turbine incorporating such bearings was subjected to operating trials. The traditional forms of segmented journal bearings were found in some cases to be inferior to elliptical bearings in their effect on the vibration resistance of the turbine rotor. It is expedient to carry out elliptical reaming of the segmented bearings so as to combine in their design the advantages of traditional segmented bearings and elliptical bearings: then the turbine power threshold can be almost doubled. Turbine vibration resistance is analyzed as a function of the presence of various types of bearings, and the control valve opening sequence, and it is found that changing that sequence so as to increase the load on journals No 1 and 2 is an effective measure for the types of bearings considered. Figures 5; references 15 (Russian).

[297-1386]

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